

# R E P O R T R E S U M E S

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DATA PROCESSING CURRICULUM FOR EDUCATORS. FINAL REPORT.

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THIS CURRICULUM DESIGN COULD BE USED (QUITE POSSIBLY WITH INSERVICE TRAINING SESSIONS) BY AN INSTRUCTOR EXPERIENCED IN DATA PROCESSING TO FAMILIARIZE EDUCATORS WITH THE COMPUTER AND TO TEACH THEM A SYSTEMS APPROACH TO ITS USE IN THE FIELD OF EDUCATION. THE CURRICULUM CONSISTS OF AN OUTLINE OF THE POINTS TO BE COVERED IN EACH LESSON, SUPPLEMENTED BY A STATEMENT OF OBJECTIVES, AUDIO-VISUAL AID SUGGESTIONS, AND PRACTICAL CLASSROOM EXERCISES. TOPICS INCLUDE--A HISTORY OF DATA PROCESSING, DATA PREPARATION, COMPUTER HARDWARE AND CAPABILITIES, TEACHING USE OF COBOL (A COMPUTER LANGUAGE), PROBLEM-SOLVING TECHNIQUES, APPLICATIONS, CRITERIA FOR COMPUTER SELECTION, AND SOLUTION OF A PROBLEM THAT IS INDIVIDUAL IN NATURE. CLASSROOM AND LABORATORY TIME REQUIRED TO TEACH EACH OF THE PHASES OF THE CURRICULUM IS ESTIMATED, THE TOTAL ESTIMATE FOR THE CURRICULUM BEING 258 HOURS. A CASE STUDY OF VOTING BEHAVIOR IS USED TO DEMONSTRATE THE INTEGRATION OF SYSTEMS ANALYSIS AND PROGRAMING AND TO GIVE EXPERIENCE IN THEIR USE. A BRIEFLY ANNOTATED BIBLIOGRAPHY IS GIVEN BUT IS NOT CORRELATED BY PAGE OR VOLUME TO ANY PARTICULAR LESSON OR PART OF A LESSON. ADDITIONAL REFERENCES IN THE APPENDICES INDICATE PROFESSIONAL AND INDUSTRIAL SOURCES FOR COURSE INFORMATION AND AUDIO-VISUAL AIDS. (HJ)

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**September, 1968**

**U.S. DEPARTMENT OF  
HEALTH, EDUCATION, AND WELFARE**

**Office of Education  
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**DATA PROCESSING CURRICULUM FOR EDUCATORS**

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## INTRODUCTION

The data processing industry is one of the most rapidly expanding industries in the world. Each and every day, new solutions to age old problems are derived through data processing. The rapid escalation and new technological breakthroughs make possible still further expansion of the problem solving capabilities of data processing equipment. However, this dynamic growth has created a "people gap" that leaves the problem solving capabilities of computers widely untapped. Since data processing has such a great impact on all of our lives and will have an even greater one, it is imperative that knowledge of the industry be more thoroughly explored. An awareness of its abilities and potential by diversified groups will open the spectrum of data processing even wider. Computer applications are not limited to banking, inventory control, or mathematical computations. They are assuming a prominent place in every aspect of modern living. This importance is growing phenomenally and we must meet the challenge.

Data processing manufacturers are conducting crash programs that develop manpower resources to support computer operations, however, this cannot begin to fulfill the need. We must now familiarize persons outside the industry with data processing in order to bridge the gap.

The most logical approach is to inform teachers of the tool at hand. They will better understand the relationship between the computer

and the classroom; discover a new education resource; and, in turn, convey an understanding of data processing to the student. The teacher is the necessary link to expand the electronic age.

In February, 1967, a report on computers issued by the President's Science Advisory Committee stated that "It is of the utmost importance to keep in mind that computing should not be thought of primarily as a new subject to be taught in addition to all the other important material now in the curriculum. Teachers who make use of computers in a wide variety of subjects have found that their material can be taught more rapidly, more thoroughly, and more meaningfully with the aid of computers . . . ."

This curriculum is designed to:

1. Develop participant proficiency in the functions and uses of electronic data processing.
2. Allow the teacher to utilize and develop, new techniques within his own area and/or pursue the teaching of data processing.
3. Generate electronic data processing as an effective classroom tool.

The course assumes no prior knowledge of data processing. Its only pre-requisites are an inquisitive mind and the motivation to keep abreast of today's progress and the demands of tomorrow's world.

The instructor who will conduct the course outlined in the curriculum, must be experienced in data processing. This means some

practical experience as a programmer/analyst working in the data processing industry. It should include exposure to the higher level languages plus knowledge of basic assembly language. In most cases two or three years of experience coupled with the curriculum outline and documentation will produce a meaningful and constructive course. In this vein, the computer manufacturers are an excellent source of manuals, visual aids and other information. In the past they have proven to be cooperative, and understandably so, since this industry benefits from any such undertaking. It should be noted here that as in all other subject matters, formal schooling is only a base upon which to build for the future. The continued acquisition of new information is all the more important in a dynamic, ever changing subject matter such as data processing. The instructor's education and experience should be complemented by an effort to stay abreast of the state of the art, via technical journals, societies, and seminars.

This curriculum has been designed to fulfill a need in the field of education. Through its subject matter each teacher will be able to bring his individual discipline up to date. The curriculum may be used as a full time course but will probably be more widely received if it is used on an inservice basis. The outlines include suggested time allotments, based on three (3) hour class sessions, which may be utilized in various ways. The total hours suggested for each segment assume a



class composed of professional educators. An expansion of the hours would be indicated if the curriculum is to be used for other purposes.

Phase One of the curriculum becomes the basis on which the class participant can build. Beginning with a brief history of data processing, its cause and effects, it goes on to acquaint the student with data preparation and computer hardware, that is, the actual equipment. The speeds at which various functions are performed is beyond basic comprehension; i.e. transferring data at the rate of two hundred forty thousand (240,000) digits per second, or the retrieving of any of two hundred million (200,000,000) characters in less than one tenth (1/10) of a second. These fantastic capabilities stimulate the imagination and quickly capture student interest. Phase One also introduces the tools necessary to implement computer systems and make "electronic brains" function in a useful manner.

The last section in Phase One embodies teaching use of the COBOL programming language. COBOL is an acronym for Common Business Oriented Language. This allows people to write statements in English that are later translated by the computer into its own language. There are many other languages, but COBOL was chosen here since it is capable of solving problems of many varieties and is not restricted to pure mathematical equation solving. Another reason is the ease of teaching and the readily understandable documentation that is a natural by-product.



The successful completion of Phase One with its programming exercises is quite rewarding to anyone. The gap has been bridged and an understanding of the fundamentals has been acquired. No longer is a computer a mystery. New ideas will have come forth during this phase from most of the participants.

Phase Two deals with the overall approach to utilizing computer technology as a problem solving tool. The information acquired in Phase One is now applied to the systems and procedures area to form a solid base in problem solution, through the use of data processing equipment and techniques. Discussions and classroom problems illustrate applications of general interest in government, industry, and school administration and serve to illustrate the feasibility of the use of computers in familiar situations. At this point, the participant will have acquired an understanding of not only the fundamentals of data processing, but also the broader aspects of computer technology.

The programming knowledge from Phase One and problem-solving techniques of Phase Two are linked in Phase Three when the participant is required to look more closely at data processing in the education field. Here the creative mind will see the relationship between this subject and the individual's specialty. These are the thoughts that will grow and be passed on from the participants to their students as part of a total awareness of the world around us.

Discussions of computer assisted instruction (CAI), seek to show

the power of this tool to the educators. Other applications in the field of education are also explored. Along with these the area of computer selection is studied. Besides the criteria used for selection, sample manufacturer proposals are presented which require the use of these criteria to determine a solution. This knowledge will be especially useful should the teacher's school be in the selection process in the future. Phase Three and the curriculum come to a close with the solution of a problem that is individual in nature. Unlike those in the first two phases, this problem is one that is generic to the discipline of the individual educator. Here the total realization of the subject matter is brought home to the individual. This is no longer a subject that is strange and unrelated. It has now demonstrated its usefulness and at the same time shown the crucial role it plays in everyone's life.

In summary, the curriculum is designed to provide a comprehensive understanding of the most recent or "third generation" concepts which will equip the participant with the knowledge to effectively utilize the power of this dynamic technology.

**THE CURRICULUM**  
**Curriculum Outline**

<u>PHASE ONE - GENERAL BACKGROUND AND PROGRAMMING</u>	<u>CLASS</u>	<u>LABORATORY</u>	<u>TOTAL</u>
Evolution of Data Processing	5	1	6
Data Representation and Management	5	1	6
Concepts of Data Processing Hardware	4	2	6
Concepts of Data Processing Software	9	3	12
Computer Processing Techniques	5	1	6
Decision Making Techniques	4	2	6
COBOL Programming	40	20	60
			<u>102</u>
<u>PHASE TWO - TECHNIQUES AND APPLICATIONS</u>			
Data Processing Systems and Procedure Concepts	18	6	24
Integration of Systems and Programming	10	20	30
Practical Applications in Industry	6	3	9
Practical Applications in School Administration	6	3	9
Advanced Class Problem	12	6	18
Information Retrieval	5	1	6
			<u>96</u>
<u>PHASE THREE - ADVANCED APPLICATIONS TO INDIVIDUAL DISCIPLINES</u>			
Concepts of Computer Assisted Instruction	5	1	6
Selection of a Computer	6	6	12
Data Processing Teaching Aids	2	1	3
Current Applications in Education	6	3	9
Individual Problem	6	24	30
			<u>60</u>
<b>TOTAL HOURS</b>			<b>258</b>

### COURSE CONTENT

The outlines which follow are intended to suggest the areas to be taught in the curriculum. Included are objectives for each section, along with case studies, suggested problems and solutions.

It is expected the material presented and texts used, will be left to the discretion of the instructor and some variation will naturally occur, due to the availability and type of equipment. Laboratory hours are flexible and may vary with each class because of individual methods of presentation. However, the quality and completeness of the course should not be compromised.

Programmed instruction courses have been successfully used as classroom texts, particularly in the introduction area of data processing. The bibliography, reference information and audio-visual aids are annotated, to aid the instructor in his selection of material. Additional sources of these elements are also listed to facilitate collection of the most recent educational aids.

The content and format of this curriculum has been provided by experienced technicians and educators, associated with successful programs in data processing, for at least five years. It has also been reviewed and approved by an advisory board consisting of educators in every level of education, managers representing a variety of computer users, and representatives of the systems and educational branches of the leading equipment manufacturers.

PHASE ONE

<u>GENERAL BACKGROUND AND PROGRAMMING</u>	<u>CLASS</u>	<u>LABORATORY</u>	<u>TOTAL</u>
Evolution of Data Processing	5	1	6
Data Representation and Management	5	1	6
Concepts of Data Processing Hardware	4	2	6
Concepts of Data Processing Software	9	3	12
Computer Processing Techniques	5	1	6
Decision-making Techniques	4	2	6
COBOL Programming	40	20	<u>60</u> 102

### EVOLUTION OF DATA PROCESSING

**Suggested Time:** Six hours

**Content:** A general description of the development of data processing technology and its relation to the individual and society.

**Major Divisions:**

- I. DATA RETENTION
- II. FORERUNNERS OF ELECTRONIC DATA PROCESSING
- III. UNIT RECORD ERA
- IV. COMPUTER ERA
- V. IMPACT OF THE COMPUTER

**Objective:**

To make the student aware of the evolution of data processing technology and the tremendous impact of the computer upon society.

In order to motivate the student, aids using the computer, such as management games, baseball games and other stimulating programs are available from the manufacturers. Audio/Visual aids showing the components of a computer may also be effective.

Since terminology can be a stumbling block to the novice, a data processing glossary may be distributed to each student. These are usually available at no cost from the manufacturers.



i

Included as supplemental material in this section,  
is the Instant "Buzzword" Generator which should  
help to overcome the apprehension attached to data  
processing terminology.

## EVOLUTION OF DATA PROCESSING

### I. DATA RETENTION

#### A. Types

1. Human Memory
2. Written Word
3. Machine Readable Form

#### B. Purposes

1. Legal
2. Historical
3. Statistical Analysis
4. Management Information
5. Decision Making
6. Problem Solving
7. Scientific Computation
8. Research
9. Scientific Simulation

### II. FORERUNNERS OF ELECTRONIC DATA PROCESSING

- A. Pascal - 1642
- B. Leibniz - 1690
- C. Babbage - 1822
- D. Hollerith - Census of 1890

### III. UNIT RECORD ERA

#### A. Need

1. Increased volume of data
2. Processing of repetitive operations
3. Manipulation of data to achieve desired results

#### B. Development

1. Punched cards
2. Electro-mechanical reading of cards
3. Progression from numeric to alphameric abilities
4. Auxiliary card-handling machines
5. Control panel wiring
6. Increased computational abilities
7. Increased flexibility
8. Increased speed
9. Acceptance by industry

### IV. COMPUTER ERA

#### A. Need

1. Complex calculations
2. Complex applications
3. Systematically recorded data

#### B. Characteristics

1. Electronic Speeds
2. Internal Memory
3. Stored program of instructions

4. Complex decision making ability
5. Automatic Operations
- C. Information Flow
  1. Input
  2. Central processing unit
    - a. Memory
    - b. Arithmetic Unit
    - c. Control Unit
  3. Output
- D. Original Models
  1. MARK I
  2. ENIAC
  3. EDVAC
  4. UNIVAC I
- E. Development
  1. Equipment
    - a. First Generation 1946 - 1957
    - b. Second Generation 1958 - 1964
    - c. Third Generation 1965 -
  2. Efficiency
    - a. Increased speed
    - b. Increased reliability
    - c. Decreased size
    - d. Decreased cost

3. Processing Methods

- a. Scientific computation
- b. Mathematical computation
- c. Statistical reporting
- d. Exception reporting
- e. System simulation
- f. Real time processing

V. IMPACT OF THE COMPUTER

A. Individual

- 1. Automatic check deduction
- 2. Credit cards
- 3. Increased volume of unsolicited advertising
- 4. Educational revolution
- 5. Development of new products
- 6. Increased employment opportunities

B. Government

- 1. Administrative
  - a. Tax reporting
  - b. Tax processing
  - c. Census
  - d. Voters registration
  - e. Health services

2. Legislative

- a. Surveys and polls
- b. Mailing lists
- c. Letter writing
- d. Voter statistics

3. Judicial

- a. Criminal information system
- b. Fingerprint classifications
- c. Accident statistical reporting
- d. Legal abstracts

C. Industry

- 1. Space program
- 2. Data processing equipment manufacturers
- 3. Data processing related industries
- 4. Dynamic inventory control
- 5. Production/Cost ratio control



### INSTANT "BUZZWORD" GENERATOR

Technology has created a new type of jargon that is nearly as incomprehensible as it is sophisticated. Philip Broughton, of the U. S. Public Health Service, developed an unusual technique, called an Instant "Buzzword" Generator, which will help you master this jargon. With it, you can generate an almost endless variety of intelligent-sounding technical terms.

The technique is easy to use. Merely select a digit from each of the three columns listed below, and combine the words opposite each number into your own technical jargon. For example, select "282", and you generate: "systematized third-generation capability," an expression bound to command instant respect - and confusion! "No one will have the remotest idea of what you're talking about," says Broughton. "But the important thing is that they're not about to admit it."

#### COLUMN 1

- 0. integrated
- 1. total
- 2. systematized
- 3. parallel
- 4. functional
- 5. responsive
- 6. optical
- 7. synchronized
- 8. compatible
- 9. balanced

#### COLUMN 2

- 0. management
- 1. organizational
- 2. monitored
- 3. reciprocal
- 4. digital
- 5. logic
- 6. transitional
- 7. incremental
- 8. third-generation
- 9. policy

#### COLUMN 3

- 0. options
- 1. flexibility
- 2. capability
- 3. mobility
- 4. programming
- 5. concept
- 6. time-phase
- 7. projection
- 8. hardware
- 9. contingency

DATA REPRESENTATION AND MANAGEMENT

**Suggested Time:** Six hours

**Content:** A description of the methods available for handling information on a computer.

**Major Divisions:**

- I. SOURCES OF DATA
- II. DATA REPRESENTATION
- III. DATA MANAGEMENT

**Objective:**

To acquaint the student with the concepts of computer files and their handling. Standard methods and technology, such as USASCII code, tape files, and disk files are discussed in detail. Other media might be briefly described (such as data cells) but emphasis is placed upon tape and disk. The concept of numbering systems is included to give the student an understanding of the machine's method of storing and computing. Simple examples of conversion from one base to another are helpful but care should be taken that these examples do not become the central point of the lecture as they are subordinate to the knowledge of data structures that the student requires at this point.

Basic theories of file handling and data collection for processing should be described.

DATA REPRESENTATION AND MANAGEMENT

I. SOURCES OF DATA

- A. Clerical files
- B. Surveys
- C. Questionnaires

II. DATA REPRESENTATION

- A. Numbering systems
  - 1. Binary
  - 2. Decimal
  - 3. Octal
  - 4. Hexadecimal
- B. Hollerith Card Code
  - 1. Numeric
  - 2. Alphabetic
  - 3. Special characters
- C. Binary Coded Decimal System (BCD)
  - 1. 6 information bits and parity bit
  - 2. 64 characters
- D. Extended Binary Coded Decimal Interchange Code (EBCDIC)
  - 1. 8 information bits and parity bit
  - 2. 96 Standard characters
- E. United States of America Standard Code for Information Interchange (USASCII)
  - 1. 8 information bits and parity bit

2. 256 standard characters

F. Miscellaneous

1. Paper tape coding
2. Other coding structures

III. DATA MANAGEMENT

A. Structure

1. Character
2. Field
3. Record
4. File
5. Volume

B. Media

1. Card
2. Paper Tape
3. Magnetic Tape
4. Random Access

C. Arrangement

1. Fixed or variable length
2. Blocked or unblocked

D. Organization

1. Sequential
2. Random
3. Index-Sequential

## **E. File Management**

### **1. Maintenance**

- a. Additions**
- b. Deletions**
- c. Changes**
- d. Re-organization**

### **2. Updating**

- a. Periodic**
- b. Real time**

### **3. Protection**

- a. Labels**
  - (1) External**
  - (2) Internal**
- b. Back up files**
- c. Re-construction procedures**

## CONCEPTS OF DATA PROCESSING HARDWARE

**Suggested Time:** Six hours

**Content:** A description of the components of a computer, the means of communication with the computer, and the design and capabilities of the hardware.

**Major Divisions:**

- I. PERIPHERAL DEVICES
- II. CENTRAL PROCESSING UNIT
- III. SUPPORTIVE DEVICES
- IV. COMMUNICATIONS DEVICES

**Objectives:**

To familiarize the student with the Central Processing Unit and its peripheral and supportive devices.

Stress should be placed on a description of the equipment and on its functions and purposes. Students are not expected to be able to operate any of the equipment at this point.

Many audio-visual aids can be utilized; pictures, transparencies and films may be used to illustrate each component, various hardware configurations, and computers in action.

One method which has proved successful is to end the lectures with a demonstration of the equipment. If



equipment is not available in the classroom, area installations have been found to be cooperative with this type of effort. It is important that the student understand that this is not an exhaustive study of all systems, but a survey of the most commonly used types of equipment.

## CONCEPTS OF DATA PROCESSING HARDWARE

### I. PERIPHERAL DEVICES

- A. Card Reader - Punch
- B. Paper Tape Reader - Punch
- C. Magnetic Ink Character Reader (MICR)
- D. Optical Character Reader (OCR)
- E. Console Typewriter
- F. Line Printers
- G. Magnetic Tape
- H. Random Access Devices
  - 1. Disk
  - 2. Drum
  - 3. Magnetic Card

### II. CENTRAL PROCESSING UNIT (CPU)

- A. Main Memory
  - 1. Purpose
    - a. Program storage
    - b. Data storage
  - 2. Structure
    - a. Core
    - b. Rod
    - c. Thin film
  - 3. Organization
    - a. Bit

b. Byte

c. Words

4. Addressing

a. Concept

b. Methods

(1) Direct

(2) Indirect

(3) Indexed

B. Arithmetic Unit

1. Purpose - Computation

2. Decimal

3. Binary

4. Floating Point

5. Arithmetic Registers

6. Shift Registers

C. Control Memory

1. Instruction

a. Initialization

b. Execution

c. Address Modification

2. Operation Register

3. Data Address Register

4. Interrupt Control

D. Input/Output Control Unit

1. Purpose - simultaneity
2. Methods
  - a. Buffering
  - b. Memory Cycle Distribution

E. Operators Console

1. System Initialization
2. Display Registers
3. Monitor
4. Sense Switches

III. SUPPORTIVE DEVICES

A. Data Preparation

1. Card
  - a. Key Punch
  - b. Key Verifier
2. Paper Tape
  - a. Typewriter
  - b. Cash Register
  - c. Adding Machine
3. Magnetic Tape Data Recorder

B. Data Manipulation

1. Card
  - a. Sorter
    - (1) Numeric sort

(2) Alphabetic sort

(3) Selection

b. Interpreter

(1) Printing of selected data

(2) Selective line printing

c. Collator

(1) Sequence check

(2) Merge

(3) Match

(4) Selection

d. Reproducer

(1) Reproduce

(2) Gang-punch

(3) Mark Sense Punch

2. Magnetic tape

a. Pooler

b. Line printer

#### IV. COMMUNICATION DEVICES

A. Purpose

B. Hardware

1. On-line adapters

2. Channels

3. Transmission lines

4. Communication interface

5. Devices

- a. Data station
- b. Video data terminals
- c. Audio response units
- d. Data collection devices



CONCEPTS OF DATA PROCESSING SOFTWARE

Suggested Time: Twelve hours

Content: A survey of the types and components of software.

Major Divisions:

- I. STORED PROGRAM CONCEPTS
- II. PROGRAMMING LANGUAGES
- III. PROGRAM DEVELOPMENT
- IV. UTILITY PROGRAMS
- V. OPERATING SYSTEMS
- VI. APPLICATIONS PACKAGES

Objective:

To impress upon the student the importance of this phase of computer technology and to familiarize him with the terminology and uses of various types of software. The student should be made aware of the evolution of software and the development of standardization in these areas. An audio tape programmed instruction course in RPG, distributed by IBM may be a useful tool and serve several purposes: the student would become familiar with one of the educational methods available in data processing, and would quickly learn to utilize a programming language.

1  
CONCEPTS OF DATA PROCESSING SOFTWARE

I. STORED PROGRAM CONCEPTS

A. Definition of stored program

B. Computer instruction

1. Components

a. Operation code

b. Operand

(1) Single address

(2) Multiple address

c. Variants

(1) Counter

(2) Control character

2. Length

a. Fixed

b. Variable

3. Basic instruction categories

a. Input/output

b. Data control

c. Arithmetic

d. Logic operations

e. Miscellaneous operations

C. Basic program components

1. Instructions

2. Data areas

- a. Input/output areas
- b. Work areas
- 3. Constants

## II. PROGRAMMING LANGUAGES

### A. Absolute

### B. Assembler

#### 1. Source Program Components

##### a. Symbolic names

(1) Constant

(2) Data

(3) Instruction

##### b. Mnemonic operation codes

##### c. Declarative Statements

#### 2. Assembler Program

##### a. Functions

(1) Translation from symbolic to machine code

(2) Storage assignment

(3) Error detection

##### b. Output

(1) Object program

(2) Program listing

### C. Compiler

#### 1. Compiler program

##### a. Functions

- (1) Translation from source statements to machine code
- (2) Multiple instruction generation
- (3) Error detection

b. Output

- (1) Object program
- (2) Program listing

2. Types

- a. Commercial
- b. Mathematical
- c. Special purpose

3. Common languages

- a. COBOL - Common Business Oriented Language
- b. Fortran - Formula Translator
- c. Algol - Algorithmic Oriented Language
- d. RPG - Report Program Generator

4. Advantages

- a. Compatability between computers
- b. Ease of programming
- c. Self documentation
- d. Ease of maintenance
- e. Reduced training time

5. Disadvantages

- a. Memory limitations
- b. Peripheral limitations

### III. PROGRAM DEVELOPMENT

#### A. Procedure

1. Problem definition
2. Procedure specifications
3. Input/output specifications
4. Coding source program
5. Translation to machine media
  - a. Card punch
  - b. Magnetic Tape Data Recorder
  - c. Direct entry keyboard device
6. Translation to machine code object program
  - a. Assembler program
  - b. Compiler program
7. Testing of program
  - a. Desk checking
  - b. Program listing checkout
  - c. Execution of object program with sample data
  - d. Trace routines
  - e. Memory dumps
  - f. Console debugging

#### B. Techniques

1. Looping
  - a. Purpose
  - b. Method
2. Addressing
  - a. Direct

- b. Indirect

- 3. Indexing

- a. Modification

- b. Advantages

- 4. Table Look-up

- a. Argument

- b. Function

- 5. Program Switches

- 6. Subroutines

- a. Open

- b. Closed

- 7. Segmentation

- 8. Macros

- a. Programmer macro

- b. System macro

#### IV. UTILITY PROGRAMS

##### A. Peripheral Conversion

- 1. Load routines

- 2. Card to tape/disk/printer

- 3. Tape to disk/printer

- 4. Disk to tape/printer

##### B. Diagnostic

- 1. Memory print

2. Clear memory
3. Tape and disk editing
4. Trace routines
5. Snapshot

#### C. Sorting

1. Methods
  - a. Sort by selection
  - b. Exchange sorting
  - c. Sort by insertion
  - d. Radix or digit sort
  - e. Sort merge method
2. Implementation
  - a. Parameter specification
  - b. User routines

#### D. Miscellaneous

1. Translators
2. Simulators
3. Flow charting programs

### V. OPERATING SYSTEMS

- A. Integrated set of inter-dependent programs
- B. Components
  1. Executive routine (Supervisor)
    - a. Resident
    - b. Calls appropriate program elements

2. Processing programs

- a. Language processors
- b. Diagnostic routines
- c. Peripheral functions
- d. User programs
- e. Service (maintenance) functions
  - (1) System generator
  - (2) System library functions

C. Primary functions

- 1. Loading programs
- 2. Communication between operator and system
- 3. Handling errors and restart facilities
- 4. Logging events
- 5. Reduce operator intervention
- 6. Automatic program calling
- 7. Simultaneous operation of input/output devices
- 8. Allocation of input/output devices
- 9. Allocation of memory

D. Additional functions

- 1. Job scheduling - priority specifications
- 2. Multi-processing
- 3. Communications facilities

E. Hardware Requirements

- 1. Resident device
- 2. Memory



F. Performance considerations

1. Reserved equipment
2. Running overhead time
3. Maintenance effort
4. Increased efficiency of operation

VI. APPLICATIONS PACKAGES

A. General description

B. Sources

1. Manufacturers
2. User groups
3. Software houses

C. Examples

1. Banking

- a. Savings accounting
- b. Demand deposit accounting

2. Education

- a. Student scheduling
- b. Grade reporting

3. Manufacturing

- a. Inventory control
- b. Production control

4. Medicine

- a. Hospital accounting
- b. Patient records

5. Scientific

- a. Regression Analysis
- b. Contour Mapping

6. Management

- a. PERT
- b. IMPACT

7. General

- a. Payroll processing
- b. Personnel records

D. Implementation considerations

- 1. Modifications
- 2. Documentation Maintenance
- 3. Programming effort
  - a. File creation
  - b. Specialized programming languages

COMPUTER PROCESSING TECHNIQUES

Suggested Time: Six hours

Content: A description of the methods used in applying computer technology to data handling.

Major Divisions:

- I. BATCH PROCESSING
- II. MULTIPROGRAMMING
- III. REAL-TIME PROCESSING
- IV. TIME-SHARING

Objective:

To acquaint the student with the development of current technology. The evolution of these methods should be discussed in terms of hardware, and application. It should be pointed out that a new technique does not necessarily obsolete other methods; that individual requirements dictate the methodology, e.g., batch processing would be a proper solution to many data handling problems whenever critical time response is not a factor.

At this point the student has been introduced to data representation and its management, and the hardware, which in effect indicates "what" constitutes a computer; this section explores "how" a computer is utilized.

This portion of the course is intended to give a basic understanding of these concepts, but care should be taken not to dwell upon the technical details, as the student is not expected to develop sophisticated techniques for these applications.

COMPUTER PROCESSING TECHNIQUES

I. BATCH PROCESSING

A. General description

1. Collection of data
2. Periodic processing
3. Output
  - a. Statistical reports
  - b. Exception reports
  - c. Updated files

B. Sequential files

1. Media
  - a. Punched cards
  - b. Magnetic tape
2. Sorting requirements
3. Non-destructive updating

C. Random Access Files

1. Media
  - a. Disk
  - b. Drum
  - c. Magnetic Cards
2. Organization
  - a. Sequential
  - b. Random
    - (1) Randomizing theory

- (2) Chaining
- c. Index Sequential
  - (1) Data key
  - (2) Overflow areas
  - (3) Index
- 3. Destructive updating
- 4. File re-organization

## II. MULTIPROGRAMMING

### A. General

- 1. Definition
- 2. Purpose
- 3. Reasons
  - a. High speed of CPU
  - b. Relative slow speed of peripheral devices

### B. Hardware developments

- 1. Buffering devices
- 2. I/O interrupt mechanism

### C. Applications

- 1. Simultaneous Peripheral Operations On-Line (SPCOL)
- 2. Processing of multiple programs with varying functions

### D. Advantages

- 1. Greater utilization of hardware
- 2. Replacement of multi-computer installations with single processor

3. Standardization of procedures for single computer.

### III. REAL-TIME PROCESSING

#### A. General

1. Definition

2. Purpose

- a. Immediate inquiry response
- b. Message switching
- c. Data collection
- d. Data dissemination

#### B. Technological developments

1. Communications facilities
2. Remote device terminals
3. Large random access files
4. Queueing concept

#### C. Applications

1. Telecommunications
2. Inquiry processing
3. Remote up-dating

### IV. TIME-SHARING

#### A. General

1. Definition

2. Purpose

- a. Multiple users
- b. User cost economy

c. Efficient hardware utilization

B. Technological developments

1. Real-time characteristics
2. Memory partitioning and protection
3. Virtual memory-paging

C. Applications

1. Program preparation, modification, and testing.
2. Scientific and engineering calculation.
3. Education
4. Text editing and modification
5. Message switching and communications
6. Horse betting

D. Problem Areas

1. Data security
2. Federal control and regulation of communications
3. Costs
  - a. Terminals
  - b. Communications lines
  - c. Computer time



## DECISION MAKING TECHNIQUES

**Suggested Time:** Six hours

**Content:** A presentation of techniques used for problem description and documentation.

**Major Divisions:**

- I. PURPOSES OF DECISION MAKING TECHNIQUES
- II. FLOW CHARTING
- III. DECISION TABLES

**Objectives:**

To allow the student to become familiar with visual decision making techniques and to emphasize their relation to the detailed documentation which must be a part of a properly designed data processing system. Laboratory problems should be used to illustrate the sequential and logical development of procedures necessary to solve problems.

The Internal Revenue Bureau Tax Tables may be used as an example of a decision table, which is familiar to everyone.

## DECISION MAKING TECHNIQUES

### I. PURPOSES OF DECISION MAKING TECHNIQUES.

- A. Communication tool between management, systems analyst and programmer
- B. Meaningful and simple classifications of operations
- C. Pin-pointing problem areas
- D. Estimating programming requirements
- E. Documentation

### II. FLOW CHART

#### A. Types

- 1. Systems flow chart
- 2. Procedure flow chart
- 3. Method flow chart
- 4. Block diagram

#### B. Standard Symbols

- 1. Input
- 2. Decision
- 3. Operations
- 4. Output
- 5. Direction of flow
- 6. Files
- 7. Auxiliary equipment
- 8. Remote references
- 9. Annotations

C. Symbol Specialization

1. Processing

- a. Manual
- b. Unit Record
- c. Computer

2. Charting

- a. Flow Chart
- b. Block Diagram

D. Flow Charting Tools

- 1. Templates
- 2. Charting Work Sheets

E. Laboratory

III. DECISION TABLES

A. Types

- 1. Limited entry
- 2. Extended entry
- 3. Mixed entry

B. Components

- 1. Heading
- 2. Condition stub
- 3. Condition entry
- 4. Action stub
- 5. Action entry

C. Procedures

- 1. Define condition

2. Determine number of decision rules
3. Test conditions
4. Specify actions for each rule
5. ELSE rule
6. Segmentation of tables
7. DO and GO TO action stubs

D. Laboratory

SUGGESTED LABORATORY PROBLEMS

PROBLEM NO. 1

Three numerical values are to be tested to determine which is highest. Assume none are equal.

PROBLEM NO. 2

Same as problem no. 1 but there may be equal values.

PROBLEM NO. 3

Hire a systems analyst taking into consideration factors such as age, education, experience, etc.

PROBLEM NO. 4

Test sales orders for approval, considering a ceiling amount of credit and whether the initial credit rating is good or poor.

COBOL PROGRAMMING

Suggested Time: Sixty hours

Description: A thorough study of the COBOL language accompanied by laboratory exercise in the use of the language.

Major Divisions:

- I. COBOL GENERAL CHARACTERISTICS
- II. PUNCTUATION
- III. LITERALS
- IV. FIGURATIVE CONSTANTS
- V. COBOL CODING SHEET
- VI. IDENTIFICATION DIVISION
- VII. ENVIRONMENT DIVISION
- VIII. DATA DIVISION
- IX. PROCEDURE DIVISION
- X. MISCELLANEOUS CLAUSES & VERBS
- XI. SOFTWARE EXERCISES

Objective:

An extensive course in COBOL is included in the curriculum to provide the student with experience using a problem-oriented language. COBOL, using English language terminology, was selected as the language to be taught in this curriculum for several reasons: COBOL has become an industry standard, and

no technical background is required. The language is adaptable to problem-solving in most areas and not restricted to any discipline. The curriculum is in conformance with standards established for COBOL-65. Vendor manuals should be utilized for introduction and clarification of optional elements. This section offers an opportunity for the student to obtain "hands-on" experience in programming. It is useful to incorporate as many computer problems as time allows, since experience indicates student interest and motivation is greatly enhanced in this manner.

In the event that a computer is not readily available, it may be possible to rent time at a commercial facility and utilize "remote" testing. In this method all student problems are submitted to an experienced operator. While this method is not as dramatic as the "hands-on" method, it still serves to enhance the course, as the student will be gaining experience in the use of the language.

Software exercises in this section is included to expose the participant, to some of the necessary functions in utilizing an operating system.

COBOL PROGRAMMING

**I. COBOL GENERAL CHARACTERISTICS**

**A. Structure**

1. Divisions
2. Sections
3. Paragraphs
4. Sentences
5. Statements
6. Words
7. Characters

**B. Standard Character Set**

1. Words
2. Punctuation
3. Editing
4. Relations

**C. Words**

1. Reserved words
  - a. Key words
  - b. Optional words
2. Data-names

**D. Statements**

1. Purpose
2. Components
3. Types



- a. Imperative
- b. Conditional
- c. Compiler-directing

- (1) EXIT
- (2) NOTE
- (3) INCLUDE

#### 4. Connectors

### E. Sentences

- 1. Components
- 2. Termination
- 3. Separators

### F. Paragraphs

- 1. Components
- 2. Name

### H. Divisions

- 1. IDENTIFICATION
- 2. ENVIRONMENT
- 3. DATA
- 4. PROCEDURE

## II. PUNCTUATION

- A. Period
- B. Comma
- C. Semi-colon
- D. Parenthesis
- E. Quotes

### III. LITERALS

#### A. Types

1. Non-numeric class
2. Numeric class

#### B. Usage

### IV. FIGURATIVE CONSTANTS

#### A. Types

#### B. Usage

### V. COBOL CODING SHEET

#### A. Page and serial number

#### B. Body

#### C. Ident

#### D. Continuations

### VI. IDENTIFICATION DIVISION

#### A. Purpose

#### B. Coding Format

#### C. Entries

##### 1. Required

###### a. IDENTIFICATION DIVISION

###### b. PROGRAM-ID

##### 2. Optional

###### a. DATE-WRITTEN

###### b. DATA-COMPILED

###### c. AUTHOR

d. INSTALLATION

e. SECURITY

f. REMARKS

## VII. ENVIRONMENT DIVISION

A. Purpose

B. Coding form

1. Division and section names

2. Paragraphs

C. Configuration section

1. Purpose

2. Entries

a. SOURCE-COMPUTER

b. OBJECT-COMPUTER

c. SPECIAL-NAMES

D. Input-Output Section

1. Purpose

2. Entries

a. FILE-CONTROL

b. I/O-CONTROL

E. Laboratory Exercise-Problem No. 1

## VIII. DATA DIVISION

A. Purpose

B. Format

1. Division and section names

2. Entry

**C. Definitions**

1. Field of information

2. Record

3. Block

4. File

**D. Structure**

1. DATA DIVISION

2. FILE SECTION

3. File Description

a. FD file-name

(1) RECORDING MODE IS

(2) BLOCK CONTAINS XXX RECORD(S)/CHARACTERS

(3) LABEL RECORDS ARE

(4) VALUE OF IDENTIFICATION IS

(5) DATE-WRITTEN

(6) DATA RECORD(S) IS/ARE

b. Record Description

(1) Hierarchial structure

(2) Group and elementary items

(3) Entries

(a) Level-numbers

(b) Data-name

(c) Descriptive clauses

(d) PICTURE

(e) SIZE IS XXX TO YYY CHARACTERS DEPENDING  
ON DATA-NAME-3

(f) USAGE

(g) JUSTIFIED RIGHT

C. Qualification

4. WORKING-STORAGE SECTION

- a. Temporary working locations
- b. Non-contiguous items
- c. Record descriptions

5. CONSTANT SECTION

E. Laboratory Exercises:

- 1. Picture Clauses - Problem No.2
- 2. Data Division - Problem No.3
- 3. Environment and data division - Problem No.4

IX. PROCEDURE DIVISION

A. Format

- 1. Section
- 2. Paragraph name

B. Verbs

- |          |          |             |             |
|----------|----------|-------------|-------------|
| 1. OPEN  | 5. MOVE  | 9. EXAMINE  | 13. NOTE    |
| 2. CLOSE | 6. GO TO | 10. ACCEPT  | 14. PERFORM |
| 3. READ  | 7. STOP  | 11. DISPLAY | 15. EXIT    |
| 4. WRITE | 8. IF    | 12. ALTER   | 16. USE     |

**C. Arithmetic Verbs**

1. ADD
2. SUBTRACT
3. MULTIPLY
4. DIVIDE
5. COMPUTE

**D. Arithmetic Rules**

1. Operands
2. Storage of result
3. Use of literals
4. Truncation
5. Rounding
6. Editing

**E. Laboratory Exercise - Problems No. 5, 6, 7.**

**F. Data Tables**

1. Subscripting
2. REDEFINES
3. OCCURS

**G. Laboratory Exercise - Problems No. 8, 9, 10.**

**X. MISCELLANEOUS CLAUSES & VERBS**

**A. Environment Division**

1. COMMON-W-STORAGE
2. SEGMENT-LIMIT INTEGER
3. ASSIGN OBJECT PROGRAM
4. RETAINING

5. RESERVE (10) ALTERNATE AREAS

6. APPLY

7. RERUN

B. Data Division

1. COPY

C. Procedure Division

1. INCLUDE

2. LOAD

3. CALL

4. Corresponding Options

a. ADD

b. MOVE

c. SUBTRACT

D. Laboratory Exercise - Problems No. 11, 12, 13.

XI. SOFTWARE EXERCISES

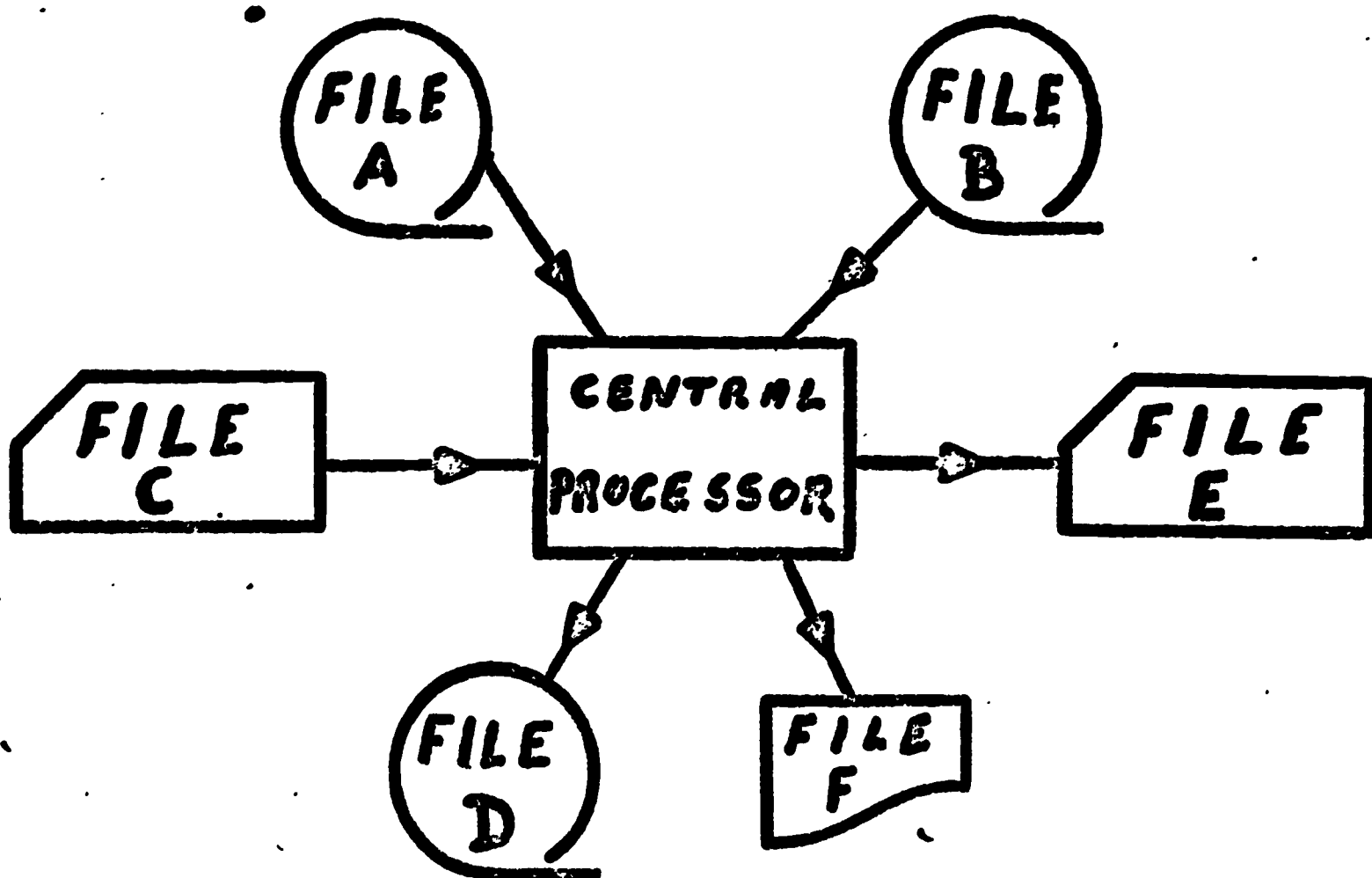
Laboratory Exercises - Problems No. 14, 15, 16, 17.

Exercises in preparing control cards for specific jobs utilizing a computers operating system.

LABORATORY: PROBLEM NO. 1

**IDENTIFICATION AND ENVIRONMENT DIVISION PROBLEM**

Write the complete identification and environment divisions for the COBOL run charted below.



**NOTES:**

1. Program and file names may be chosen by the programmer.
2. Program access is restricted to those persons assigned to this COBOL class.
3. The problem is a classroom exercise in writing the Identification and Environment Divisions for a COBOL program.
4. File-B is multi-reel and should be assigned to 2 tapes.
5. Memory for the object program is restricted to 32,110 characters.
6. Assume File-F will require more than 1 printed page.



**LABORATORY: COBOL CLASS PROBLEM - PROBLEM NO. 2**

**PICTURE CLAUSES**

Using the PICTURE clause, code the Data Division entries necessary to describe the fields given below:

**Problems:**

1. A numeric field of 6 digits to be used in arithmetic operations.
2. An alphabetic field of 20 characters.
3. A numeric field of 6 digits to be used in arithmetic operations with decimal alignment one position to the left of the least significant digit.
4. A numeric field of 6 digits to be used in arithmetic operations with decimal alignment four positions to the right of the least significant digit.
5. A numeric field of 8 digits with floating dollar sign, comma, and decimal point.
6. A numeric field of 5 digits which will be printed with a positive or negative sign depending on the value of the sending field.
7. A numeric field of 8 digits with floating dollar sign, comma, decimal point and debit symbol of negative.
8. An alphabetic field of 50 characters, containing students name and address.
9. A numeric field of 10 characters with fixed dollar sign and check protection.
10. An alphabetic field of 12 characters with initial value of blanks.

LABORATORY: PROBLEM NO. 3

1. On a coding sheet write the entire DATA DIVISION entry for the following card file.

Card Columns	1 - 4	Department Number
Card Columns	5 - 13	Social Security Number
Card Columns	14 - 33	Employee Name
Card Columns	34 - 53	Employee Address
Card Columns	54 - 73	City and State
Card Columns	74 - 79	Zip Code
Card Columns	80	Card Code "A"

LABORATORY: ENVIRONMENT AND DATA DIVISION PROBLEM - PROBLEM NO. 4

Write the ENVIRONMENT AND DATA DIVISION for the following files to be used in a COBOL program:

INPUT Card images on tape.

There are standard labels on the tape.

FORMAT

<u>Card Cols.</u>	<u>Data Field</u>	<u>Type Data</u>
1 - 15	City & State	Alphabetic
20 - 34	Stock Number	Alphanumeric
35 - 39	Quantity	Numeric
40 - 43	Unit Price	Signed Numeric

OUTPUT #1

Normal data records on tape, 10 records per block.  
There may be more than one reel of output.  
All normal labeling conventions apply.

FORMAT

<u>Data Field</u>	<u>Type Data</u>
1 - 15 Stock Number	Alphanumeric
31 - 35 Quantity	Signed Numeric
36 - 39 Unit Price	Numeric (See Note 2)
40 - 46 Total Price	Signed Numeric (See Note 2 & 3)
16 - 30 City & State	Alphabetic

PROBLEM NO. 4 (CONTINUED)

OUTPUT #2

Print line images.

There are 2 print line formats; 1 for detail information and 1 for summary information

Detail Format

<u>Data Field</u>	<u>Left-Most Print Position</u>	<u>Notes</u>
Stock Number	6	
City & State	25	
Unit Price	50	2, 4 & 5
Quantity	70	5 & 6
Total Price	110	2, 3, 4, 7 & 8

SUMMARY FORMAT

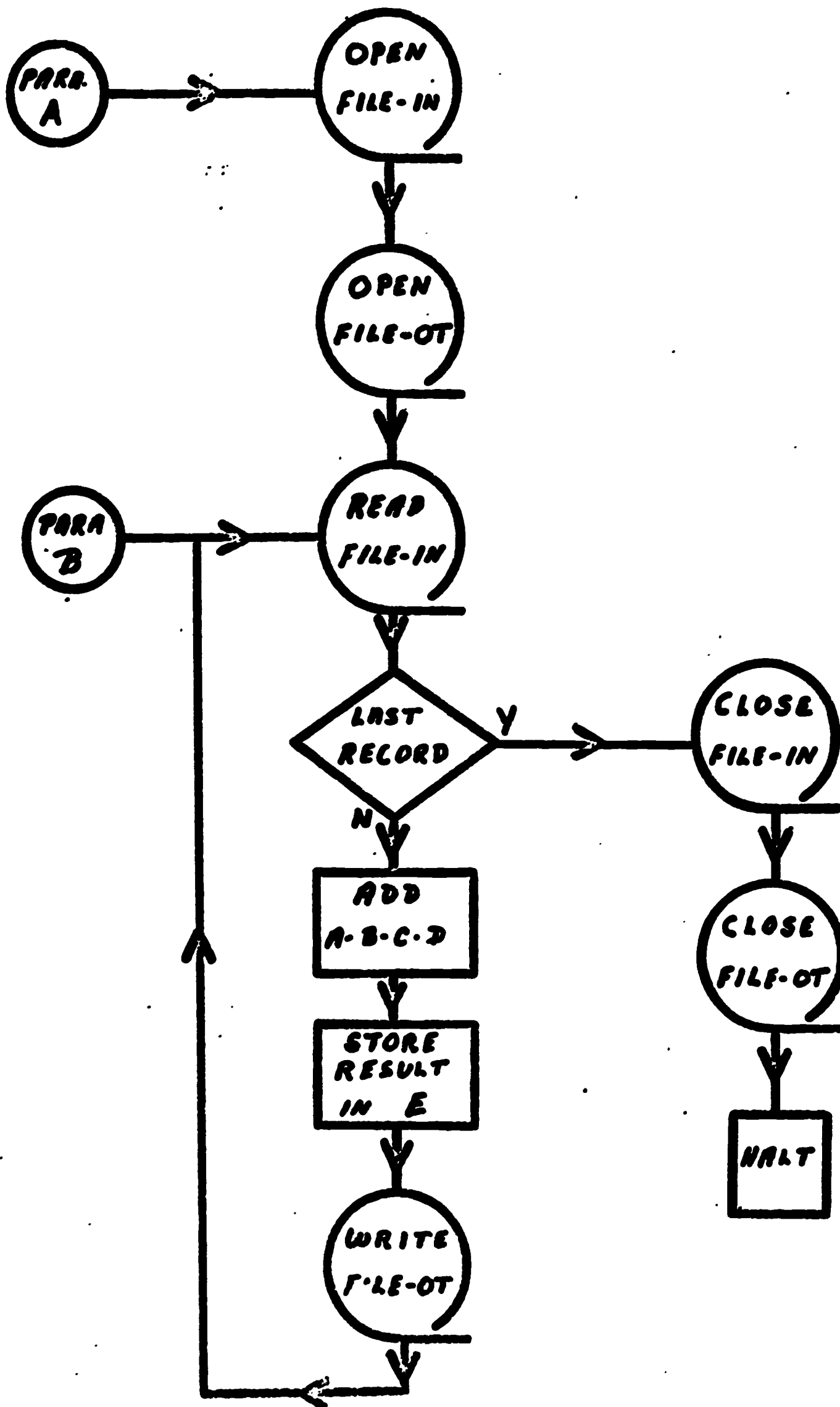
<u>Data Field</u>	<u>Left-Most Print Position</u>	<u>Notes</u>
Card Count	10	Allow 5 digits
Total Quantity	27	3 & 9
Average Quantity	70	Allow 5 digits
Average Unit Price	110	2, 3, 4, 8, & 10

NOTES:

1. Object program is to operate using only 16,384 characters of memory and 4 tape units.
2. Assume to represent a dollars and cents value.
3. Allow for seven numeric digits.
4. Insert a decimal point and/or commas as appropriate.
5. Zero suppress entire field.
6. Print a "-" symbol to the right of the least significant character if quantity is negative.
7. Floating dollar sign.
8. Print "CR" if Total Value is negative.
9. Zero suppress all but the low-order 4 digits, no punctuation.
10. Fixed dollar sign and check protect all except the low-order 3 digits.

LABORATORY: PROBLEM NO. 5

CODE THE COBOL PROCEDURE DIVISION FOR THE FOLLOWING FLOW CHART:



LABORATORY: INDIAN PROBLEM NO. 6

FLOW CHART THEN CODE IN COBOL THE INDIAN PROGRAM.

The Indians sold Manhattan Island to the white man in 1627 for \$24.00.  
If the Indians had put the \$24.00 in the bank in 1627, what would their  
bank balance be in 1968 at 3% interest compounded annually?

**LABORATORY: F.I.C.A PROBLEM NO. 7**

Flowchart and code the four Cobol Divisions necessary to calculate F.I.C.A. on a weekly basis. The F.I.C.A. percentage is 4.4% on the first 7,800.00 of the individual's annual salary. The maximum amount of F.I.C.A. in any 12 month period is \$343.20.

Calculate F.I.C.A. and write it to the output tape also update the year to date F.I.C.A. and year to date gross.

**Input Tape**

1-5 Employee no.  
6-25 Name  
26-31 Gross pay (this week)  
32-36 F.I.C.A. (last week)  
37-41 Year to date F.I.C.A.  
42-47 Year to date Gross Pay

**Output Tape**

1-5 Employee no.  
6-25 Name  
26-31 Gross Pay  
32-36 F.I.C.A. (this week)  
37-41 Year to date F.I.C.A.  
42-47 Year to date Gross

**LABORATORY: PROBLEM NO. 8**

**Class Problem involving PERFORM AND SUBSCRIPTING.**  
**Each entry of Field 1 (in ascending order) is to be added to each**  
**5th entry of Field 2 (in descending order) giving each 2nd entry of**  
**Field 3 (in ascending order).**

**In the data division**

**Field 1 is defined as 100 5-character fields**  
**Field 2 is defined as 500 5-character fields**  
**Field 3 is defined as 200 7-characters fields.**



LABORATORY: PAYROLL-PROBLEM NO. 9

INPUT

1. Card file containing a rate table with 100 entries in ascending sequence by job number.

Format

Column 1 - "T"

Columns 2 - 4 Job number - three digits

Columns 5 - 8 Rate - four digits, three decimal positions (dollars, cents and mills)

2. Card records - one card per employee, in ascending sequence by employee number.

Columns 1 - 4 Employee number

Columns 5 - 7 Job number

Columns 8 - 11 Hours, containing two decimal positions,

OUTPUT

Printer listing, one line per employee.

Positions 1 - 4 Employee number

Positions 7 - 9 Job number

Position 12 - 16 Rate (print decimal point)

Position 19 - 23 Earnings (print decimal point)

LABORATORY: PAYROLL-PROBLEM NO. 10

Revise problem no. 09 to allow multiple cards for each employee.  
Print one line per employee showing total earnings.

**LABORATORY: PAYROLL PROBLEM - PROBLEM NO. 11**

An employee master file on tape contains 200 character records, blocked 5, with the following data:

Positions	1 - 3	Department number
"	4 - 12	Employee identification number
"	13 - 22	Employee name
"	14 - 18	Hourly rate (dollars, cents, and mills)
"	19 - 100	Other indicative information not required in this problem.
"	101 - 106	Year-to-date overtime hours (two decimal positions)
"	107 - 112	Year-to-date overtime hours (two decimal positions)
"	113 - 119	Year-to-date gross earnings (dollars and cents)
"	120 - 200	Data not required in this problem.

The file is in sequence by Employee Identification Number within Department Number.

A second input is a card file containing weekly salary information:

Card Column	1	Card Code "5"
Card Columns	2 - 4	Department number
Card Columns	5 - 13	Employee identification number
Card Columns	14 - 17	Regular hours (two decimal positions)
Card Columns	18 - 21	Overtime hours (two decimal positions)

The card file is in sequence by Employee Identification Number within Department Number.

Normally there is one card per employee, however there may be no cards for some employees (due to terminations or absences). These employees are not to be paid but their records must be maintained.

If there is more than one card for an employee, assume the first is correct and all others are errors to be printed on the console typewriter.

**Computations:**

Regular hours X Hourly rate = Regular earning  
Overtime hours X Hourly rate X 1.5 = Overtime earnings  
Regular earnings + Overtime earnings = Gross earnings

The output master file contains the same data as the input file, with the following fields updated:

- Year-to-date regular hours
- Year-to-date overtime hours
- Year-to-date gross earnings

A printer listing is to be prepared, with one line for each master record, showing:

- Department number
- Employee identification number
- Employee name
- Hourly rate
- Regular hours
- Regular earnings
- Overtime hours
- Overtime earnings
- Gross earnings

Totals are to be printed at the end of each department and a final total at the end of the report containing:

- Total regular hours
- Total regular earnings
- Total overtime hours
- Total overtime earnings
- Total gross earnings
- Total number of employees paid
- Total number of employees not paid.

LABORATORY: EMPLOYEE EDUCATION LEVEL PROBLEM - PROBLEM NO.12

1. This problem consists of reading an organization card file, counting the number of people in each of four education groups and printing a one line total for each organization.

2. An individual will be coded according to his highest degree.

3. The input card format is:

CC 1 - 10 Department Number

CC 11 - 30 Department Name

CC 31 - 70 Education codes for as many as 40 individuals

CC 80 Code of E is valid Education

Code of 9 is END OF JOB any other code is invalid.

a. There are no label records.

b. There may be one or several cards for each organization.

c. The codes are:

Code A - Graduate Degree

B - College Degree

C - High School Graduate

D - Grade School

d. If a card is read with an invalid code in Col. 80 bypass it.

4. The output print format is:

Print Pos.

1 - 10

Department Number

16 - 35

Department Name

41 - 46

Total Graduate Degrees

51 - 56

College Degrees

61 - 66

High School

71 - 76

Grade School

a. Report should be double spaced printing 51 detail lines and a columnar header on each page (abbreviations may be used in the header).

b. Each total is six digit field. The print total is a seven position edited field consisting of 6 integers and a comma.

**LABORATORY: CUSTOMER FILE CONVERSION PROBLEM: PROBLEM NO. 13**

Flowchart and code the four Cobol Divisions for the following program

**CUSTOMER FILE CONVERSION**

There are 200,000 cards in a file of customers. Create a tape file of these cards in order to convert the job to our new tape computer.

It has been decided to convert only those cards which are for customers who have done business with us in the last two years. Therefore any card with a date older then 1966 will not be written to the tape, however, we should compile a printed list of these customers so that our salesmen can call on them. All cards which are legitimate customer name and address cards will have a "C" in card column 80. Any card not having this should be ignored.

**Record Layouts**

**Card Input 1 x 80**

<u>Field</u>	<u>Card Col.</u>
Customer No.	1 - 6
Customer Name	7 - 16
Street Address	17 - 31
City	32 - 46
Attention Line	47 - 61
State	62 - 63
Zip Code	64 - 68
Date (of last sale mo. day yr.)	69 - 74
Blank	75 - 79
Customer Code "C"	80 - 80

**Tape Output 10 x 100**

<u>Field</u>	<u>Position</u>
Customer No.	1 - 6
Name	7 - 21
Street Address	22 - 41
City	42 - 61
Attn. Line	62 - 81
State	82 - 83
Zip Code	84 - 88
Date (of last sale)	89 - 94
Territory Code	95 - 96
Salesman's #	97 - 100
Tape Label = "Customer File"	

CUSTOMER FILE CONVERSION PROBLEM (CONTINUED)

Printer Output

<u>Field</u>	<u>Print Position</u>
Customer Name	10 - 24
Street Address	28 - 42
City	45 - 59
State	62 - 63
Zip Code	66 - 70    mo    da    yr
Date of last sale	75 - 82    xx - xx - xx

Heading - "Customer File Deletions"

When writing the card to tape leave space for the salesmans no. and territory code even though we will not currently have the information. Increase the size of the name, street address, and city portions of the record. The state area is 2 digits with a 5 digit zip code, conforming to the U. S. post office regulations.

LABORATORY: GRADE REPORTING-PROBLEM NO. 14

A grade reporting system uses card input containing student identification number, name, course number, course name, and course grade.

The card format is as follows:

Card Column	1	"1" (card code)
Columns	2 - 5	Student identification number
Columns	6 - 8	Course number
Columns	9 - 28	Student name
Columns	29 - 48	Course name
Columns	49 - 50	Course grade

The cards must be sorted in ascending order by student identification number in order to match the sequence of the student tape master file.

Write the control card parameters to sort the file, using card input and tape output.

LABORATORY: PROBLEM NO. 15

Catalog any previously written program permanently in the operating systems library.

LABORATORY: PROBLEM NO. 16

A tape file contains 100 character records, blocked 10. Write the necessary parameters to utilize a Tape-to-Printer utility routine to print the entire file, with each 100 character record printing on a separate line. The tape label identification is "Tape 16."

LABORATORY: PROBLEM NO. 17

A disk file contains 400 character records, blocked 2. The first half of the disk pack contains the file, the other half is used for other data. The file is to be copied on tape for backup. Write the parameters to copy the file. The disk label is "Disk 17."

PHASE TWO

<u>TECHNIQUES AND APPLICATIONS</u>	<u>CLASS</u>	<u>LABORATORY</u>	<u>TOTAL</u>
Data Processing Systems and Procedure Concepts	18	6	24
Integration of Systems and Programming	10	20	30
Practical Applications in Industry	6	3	9
Practical Applications in School Administration	6	3	9
Advanced Class Problem	12	6	18
Information Retrieval	5	1	<u>6</u> 96



## DATA PROCESSING SYSTEMS AND PROCEDURES CONCEPTS

**Suggested Time:** Twenty-four hours

**Description:** A study of the many factors involved in utilizing a computer as a data processing tool.

**Major Divisions:**

- I. SYSTEMS ANALYSIS
- II. DESIGN
- III. IMPLEMENTATION
- IV. FINALIZATION

**Objective:**

To acquaint the student with a comprehensive view of the many facets of data processing systems planning. The student should become aware that programming is a small portion of the entire operation, and that effective computer utilization is dependent upon detailed planning effort and the application of recent technology. It may be noted that systems work is an imaginative creative way of reviewing, analyzing and improving a method of operation. In larger organizations there may be a separate systems department, but very often the systems and programming functions are combined. In any event systems and programming

personnel must work hand in hand. This section concentrates on the detailed systems analysis and design that concerns computer data processing, rather than systems in general.

**DEFINITIONS:**

**System - is the complete plan**

**A system is a set of related procedures which provide the plan of action for carrying out basic objectives.**

**Procedure - steps within the system**

**Procedures are the actions or steps which are taken in carrying out a function as part of a system.**

**Operation - a step in the procedure**

**An Operation is the focal point of activity within a procedure.**

**Method - manner of performance**

**Method is the instructions for performing an operation or related series of operations.**

## **DATA PROCESSING SYSTEMS AND PROCEDURES CONCEPTS**

### **I. ANALYSIS**

#### **A. General Analysis**

##### **1. Determine problem areas**

- a. Object of complaint**
- b. Backlog of clerical work**
- c. Anticipated backlog of clerical work**
- d. Undue high cost of production**
- e. Over elaborate control measures**
- f. Not functioning according to managements expectation**
- g. Need for management information**

##### **2. Objectives**

- a. Improved management information**
- b. Improvement of time and cost/production ratio**

#### **B. Specific Problem Definition**

##### **1. Current operations of application**

##### **2. Statistical evaluation**

- a. Volume**
- b. Equipment**
- c. Personnel**
- d. Time**
- e. Cost**

#### **C. Determine Method of Improvement**

- 1. Electronic data processing**
- 2. Refine manual system**

3. .Combination of manual and electronic data processing methods

D. Scheduling considerations

1. Manpower resources
2. Financial resources
3. Equipment

II. DESIGN

A. Preliminary considerations

1. Equipment
  - a. Ability of computer to handle additional load
  - b. Need for new or faster peripherals
2. Utility software
  - a. Availability
  - b. Efficiency
3. Timing estimates
  - a. Machine
  - b. Clerical
4. Processing methods
  - a. Batch
  - b. Real time
5. File organization
  - a. Sequential
  - b. Control sequenced
  - c. Random
6. Control considerations
  - a. Audit trails

- b. Input/output validity control
- c. Record count checks
- d. Cross-footing checks
- e. Back-up files
- f. File reconstruction procedures

**B. Systems Flow Chart**

- 1. File creation
- 2. File maintenance
- 3. File updating
- 4. Output

**C. Records**

- 1. Type
  - a. Input/output
  - b. Master record
- 2. Size
  - a. Pertinent data
  - b. Expansion provisions
- 3. Format
  - a. Fixed or variable length
  - b. Blocked or unblocked
- 4. Arrangement
  - a. Sequential
  - b. Control sequential
  - c. Random

**5. Limitations**

- a. Memory size
- b. Peripheral storage
- c. Program size

**D. Forms Design**

**1. Purpose**

- a. Source documents
- b. Computer reports

**2. Logical placement of items**

**3. Readability**

**4. Physical characteristics**

- a. Paper grade
- b. Color of paper
- c. Size of paper
- d. Number of carbon copies

**5. Retention period**

- a. Administrative
- b. Fiscal
- c. Legal

**6. Economies**

- a. Avoid unnecessary preprinting of computer reports
- b. Avoid unnecessary copies
- c. Utilize exception reporting (printing exceptions only)
- d. Evaluate practicality of manual processing for exceptions to rule

e. Design computer forms two or more across when printer permits

**F. Documentation**

1. Departmental procedure manuals
2. Flow charts
  - a. System
  - b. Job
3. Record layouts
4. Input/output layouts

**III. IMPLEMENTATION**

**A. Program assignment**

1. System procedures
2. Program specifications
3. Time estimates

**B. System conversion**

1. Schedule
2. Input data preparation
3. Personnel training
4. Parallel operations

**C. Documentation**

1. Management control manuals
2. Clerical procedure manuals
3. Programmers procedure manuals
4. Operators procedure manuals



#### **IV. FINALIZATION**

- A. Combine documentation**
- B. Evaluate new system**
  - 1. Cost**
  - 2. Objectives met**
  - 3. Comparison to old system**
- C. Recommendations**
- D. Final reporting**

INTEGRATION OF SYSTEMS AND PROGRAMMING

**Suggested Time:** Thirty hours

**Content:** Case study problem illustrating the inter-relationship between systems and programming.

**Major Divisions:**

- I. INTRODUCTION TO PROBLEM
- II. DEFINITION OF TERMS
- III. VOTERS REGISTRATION SPECIFICATIONS
- IV. SYSTEM FLOWCHARTS
- V. LIST OF PROGRAMS
- VI. INDIVIDUAL PROGRAM SPECIFICATIONS

**Objective:**

To enable the participant to place in proper context the intermingling elements of systems and programming.

A case study approach is used as a practical method to achieve this objective. After presentation of the problem the instructor may wish to divide the class into teams or allow the individual to try to develop his own design.. The participant should have developed the ability to create system flowcharts, program block diagrams, decision tables, forms design and programs.

The instructor may assign any or all phases of the problem as laboratory exercises.

## I. INTRODUCTION

In order to develop an appreciation of the important role of efficient design, as opposed to the subordinate role of programming in electronic data processing, the following problem has been presented to allow the participants to develop their own system. Voters' registration has been chosen as the case study, because of its general interest to the individual and the comparable simplicity of the system.

The problem may be utilized in various ways:

1. Pre-election processing
2. Post election processing
3. Combined pre and post election processing, which constitutes the complete system

A variety of solutions may be developed, and various hardware configurations may be utilized; these topics may be explored by class discussion.

The suggested solution involves a computer configuration consisting of:

1. 8,000 bytes of memory (8K)
2. Card reader
3. Card punch
4. Printer
5. Three magnetic tape units

Sequential tape processing methods are therefore utilized. If the configuration included random access devices, other techniques, such as indexed sequential file organization, might be employed.

The participants should be required to:

1. Design and flowchart a system to produce the desired results.
2. Develop a suitable master record.
3. Determine file organization.
4. Determine control requirements.
5. Design the input/output layouts.
6. Determine individual program requirements.
7. Develop one or more of the programs.
8. Document the system.

## II. DEFINITION OF TERMS

### A. Hierarchy of Political Area

1. County - municipal subdivision of a state.
2. District - a political section of a county.
3. Municipality - towns or cities within a district.
4. Ward - subdivision of a municipality
5. Precinct - subdivision of a ward.

This is the make-up of the voting area. Within each precinct there is a polling place. The area is broken into precincts to make it easier for the populace to vote.

B. Registration Period - that time before each election when, at specified locations, clerks from the voting office accept new registrations and changes to the status of previously registered voters.

C. Street List - listing of all voters by street within a district which is used by the candidates and committeemen in getting the people out to vote.

D. Committeeman - a person who is a party worker within a ward. He is elected by the people residing in that ward. His job is to build and maintain political interest within his area.

E. Voter Certificate - the card which must be signed by each voter before he casts his ballot. It becomes a permanent record. The clerks at the polling place will check the master record book for the voters

name, and then have him sign the certificate.

F. District Inspector - a person assigned by the district voting office to periodically tour his assigned district and determine if anyone should be purged from the rolls.

G. Identification Number - the number attached to each person's record when he registers. It can be a sequentially assigned number or it may be the person's social security number.

### III. VOTERS' REGISTRATION SPECIFICATIONS

A study of a voters' registration office reveals the following:

- A. The entire county is made up of six (6) districts which are divided into seventy (70) municipalities. Each municipality is further divided into wards, and precincts. This structuring is referred to as the political area.
- B. Before each election, registration periods are opened in order to accept new registrations and changes to the current records.
- C. Ten (10) days before the election, a complete list of registered voters (by street within voting districts) must be available for distribution to the candidates and local committeemen.
- D. A certificate must be prepared for each voter. This certificate is signed by each voter at the polling place and becomes a permanent record of a vote having been cast. It contains all the data on each voter. Voter records are updated with "last voting date," based on signed certificates.
- E. Those voters who do not cast a ballot in five (5) consecutive elections are sent a notice of purge. The notice is in the form of a two (2) part post card. To be reinstated, a person need only sign in the space provided and return the card. Those who do not return their card are purged from the master file.

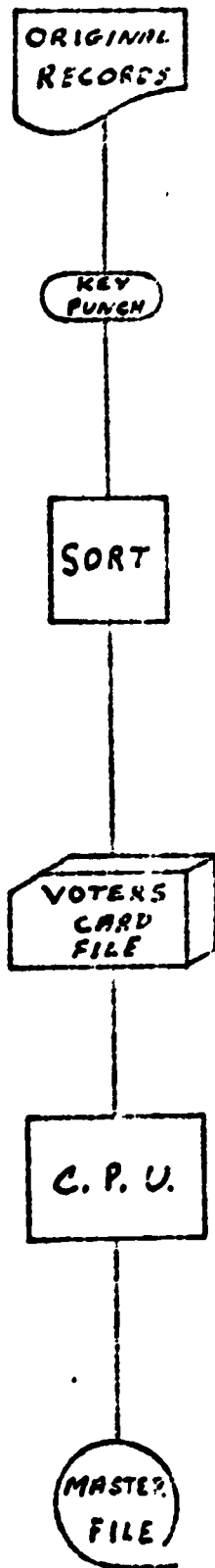
F. A voter can also be purged from the file by a district inspector, for the following reasons.

1. Deceased (or declared legally dead).
2. Declared legally incompetent
3. Committed to a penal institution
4. Committed to a mental institution
5. Moved from the area

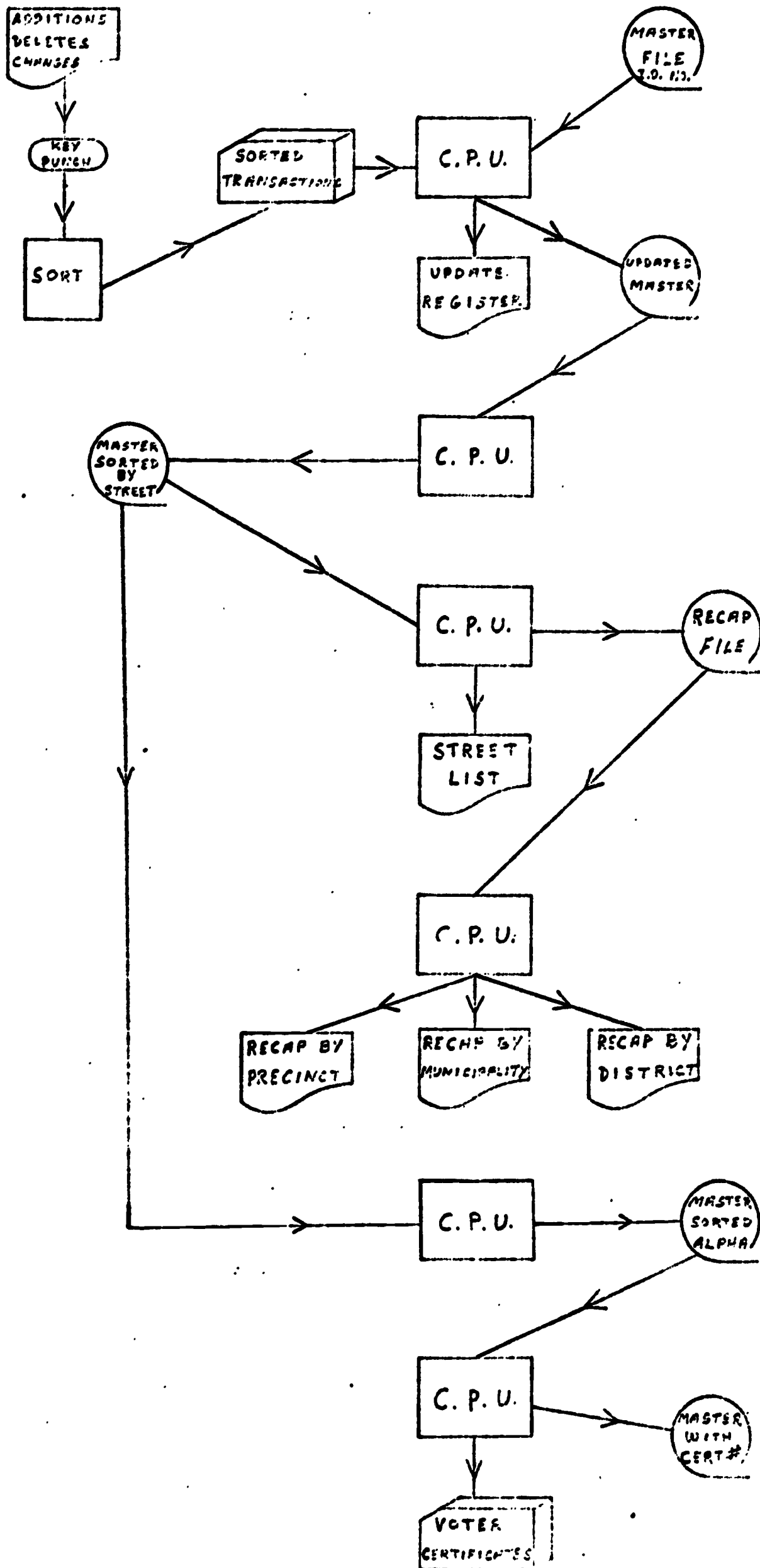


IV. SYSTEM FLOWCHARTS

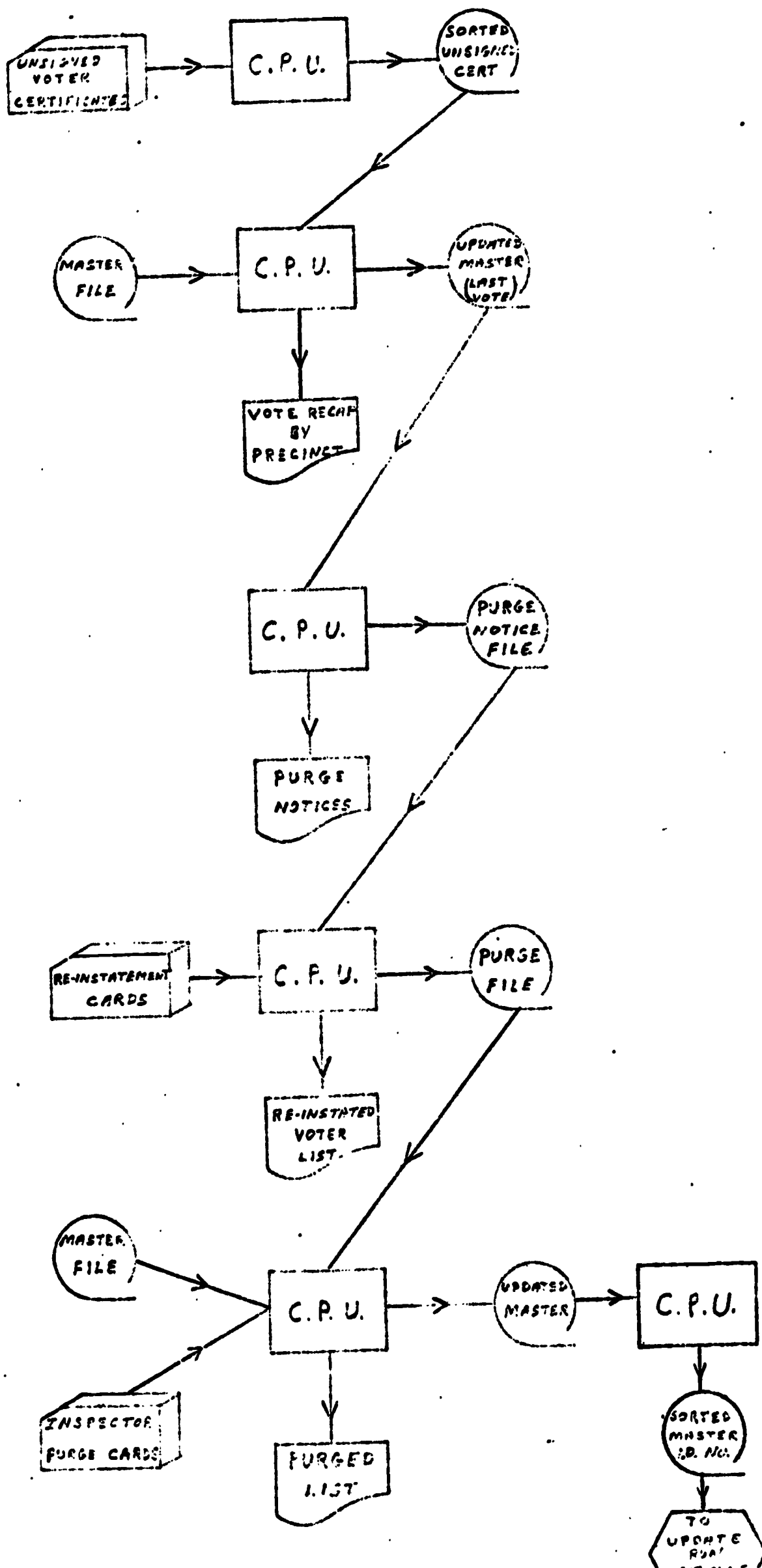
VOTER SYSTEM CONVERSION



# VOTER SYSTEM PRE-ELECTION PROCESSING



# VOTER SYSTEM POST-ELECTION PROCESSING



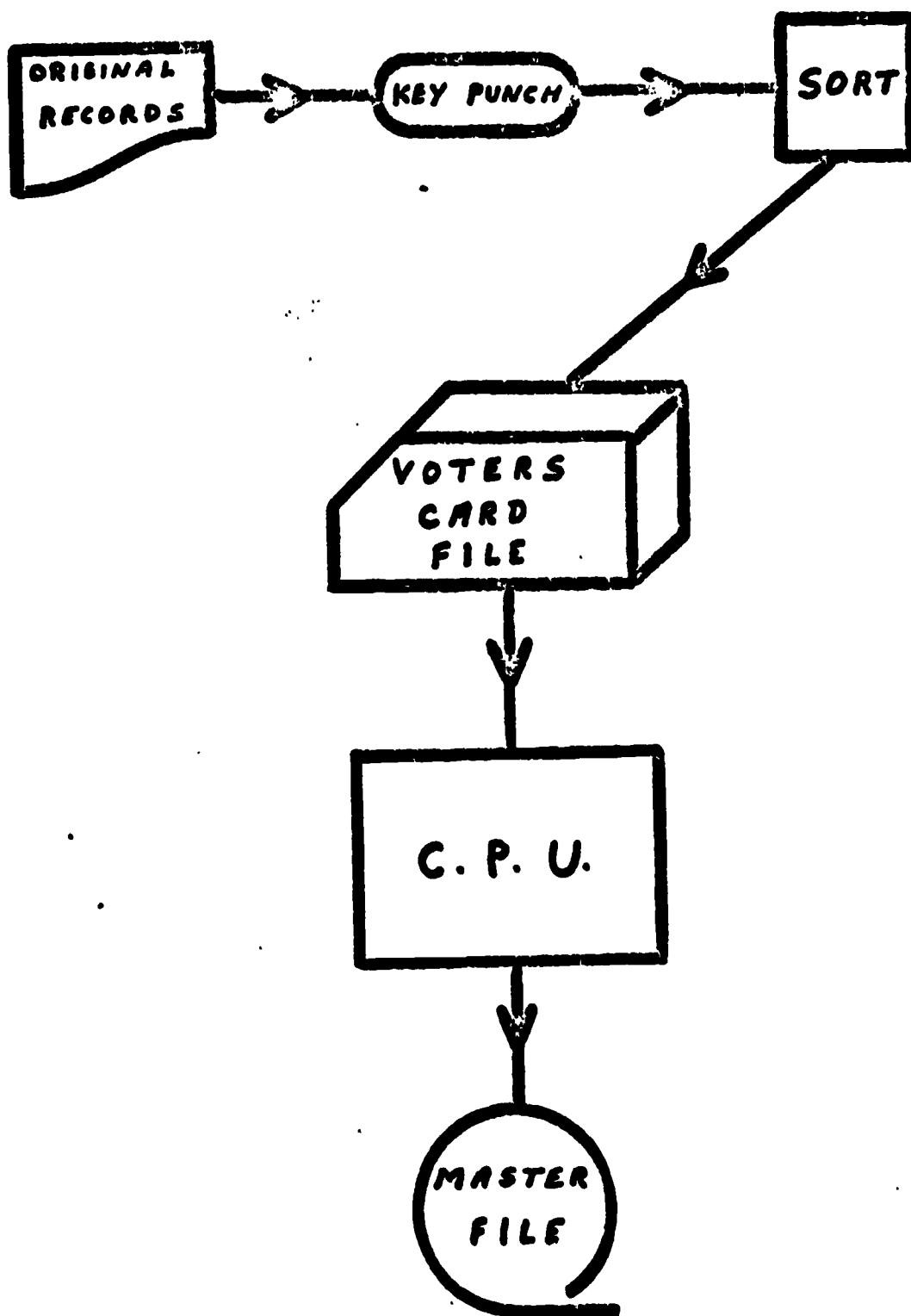
## V. LIST OF PROGRAMS

- A. Creation of Master File (Conversion Run)
- B. Pre-Election Processing
  - 1. Master File Update
  - 2. Street List Sort
  - 3. Street Lists
  - 4. Registration Recap
  - 5. Sort for Certificates
  - 6. Certificate Run
- C. Post-Election Processing
  - 1. Sort of Unsigned Certificates
  - 2. Voting Data Update
  - 3. Purge Notice Run
  - 4. Reinstatement Run
  - 5. Purge or Final Update
  - 6. Sort by Identification Number

## VI. INDIVIDUAL PROGRAM SPECIFICATIONS

- A. Program Flowcharts
- B. Program Descriptions
- C. Input/Output Formats

CONVERSION RUN



**PURPOSE:**

To create, on magnetic tape, the master file which will be used throughout the system.

### CONVERSION RUN

This run creates on magnetic tape the master file of all registered voters. As each card is read, it will be assigned a record code of (1) indicating this is the detail of an individual voter. As the file is constructed, a count is developed showing the total registrations by party and sex. A record containing these totals will be written at the end of each voting district and assigned a record code of (2). Each individual record will also go through a table look up in order to assign the proper municipality name in the address section of the master.

A convenient record size is one hundred (100) positions per item, blocked five (5).

RECORD LAYOUTS

<u>MASTER RECORD</u>		<u>TOTAL RECORD</u>	
<u>Field</u>	<u>Field Size</u>	<u>Field</u>	<u>Field Size</u>
Code	1	Code	1
Political Area	6	Political Area	6
Identification Number	6	Male Republican	6
Voter Last Name	15	Female Republican	6
Voter First Name	9	Male Democrat	6
Voter Initial	1	Female Democrat	6
Address	22	Male Others	6
Municipality	18	Female Others	6
Zip Code	5	Male Total	6
Last Voting Date	3	Female Total	6
Sex	1	Filler	<u>45</u>
Party	1	Total	100
Certificate Number	6		
Filler	<u>6</u>		
Total	100		

NOTE: For simplification of tape processing, voter records and total records are designed as 100 character records.

Purge record is the same as the master record.

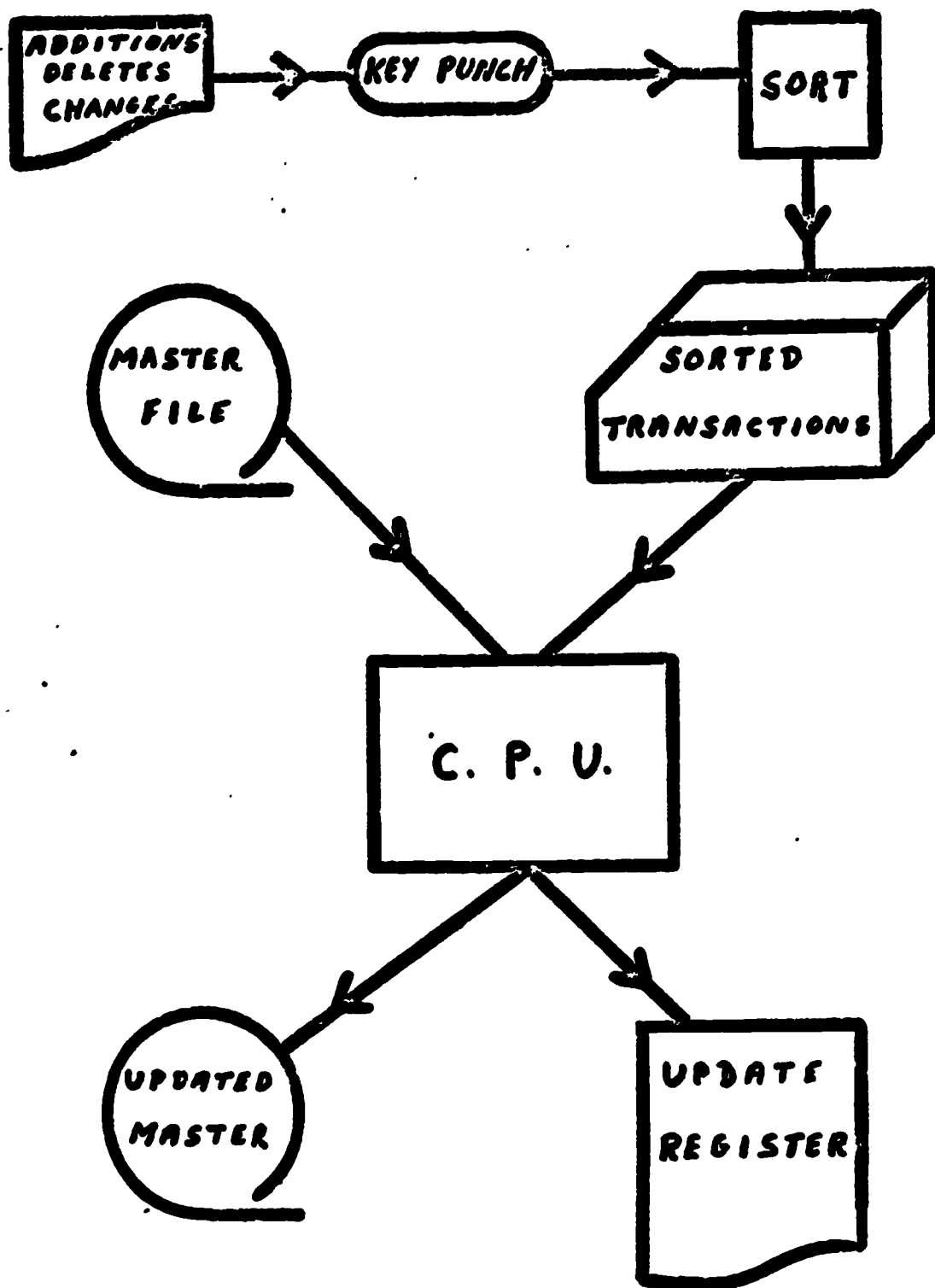
Recap record is the same as the total record.

Unsigned voters certificate record contains only the 6-digit certificate numbers, blocked 16.





MASTER FILE UPDATE



**PURPOSE:**

To add or delete registrations and to make any necessary changes in the detail of any registered voter on the master file.

MASTER FILE UPDATE

This program is to be run as soon as all the data from the voting office is received at the close of the registration period. There will be three types of transactions. The type of change is indicated by card code.

1. Additions - these are the new registrations and must contain all the detail data for the individual. New records will be inserted in file by identification number within voting districts.
2. Changes - Partial alteration of master records. Each change must contain the voting district, identification number of the record to be altered, and a change code. Only those fields that are to be changed need be punched.
3. Deletions - To remove a record from the file the card must contain the voting district and the identification number of the record to be dropped, and the delete code.

During the update, a register will be produced showing each transaction and an indication of the action taken. New total records will also be constructed and written to the file. At completion of the run, a report of total activity will be printed which will include the number of records read, the number of transactions by type and the number of records written.

## Layout Form - 80 Column Card

R	X	DISTRICT	MUNICIPALITY	WARRANT	PRECEDENCE	IDENTIFICATION NUMBER	LAST NAME	FIRST NAME	STREET NUMBER	STREET NAME	DATE SENT	DATE RECD	CODE
0		000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
1		123456	789101112	131415161718192021222324252627282930313233343536	3738394041424344454647484950515253545556575859	606162636465666768697071727374757677787980							
2		222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222
3													
4													
5													
6													
7													
8		888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888
9		999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999
		123456	789101112	131415161718192021222324252627282930313233343536	3738394041424344454647484950515253545556575859	606162636465666768697071727374757677787980							

Title ADDITIONS AND CHANGES

Prepared By

For Program

By Programmer

Checked By

Date

Remarks

2 in 80 = Addition (completely punched in columns 1-64) 3 in 80 = Change (first twelve columns must be punched then only the field being changed)

Modification

Page

Of

[illegible]

Title \_\_\_\_\_ DELETE CARD

Prepared By \_\_\_\_\_ For Program \_\_\_\_\_

By Programmer \_\_\_\_\_ Checked By \_\_\_\_\_

Date \_\_\_\_\_ Remarks \_\_\_\_\_

Column 8 must contain a 1

# Qualification

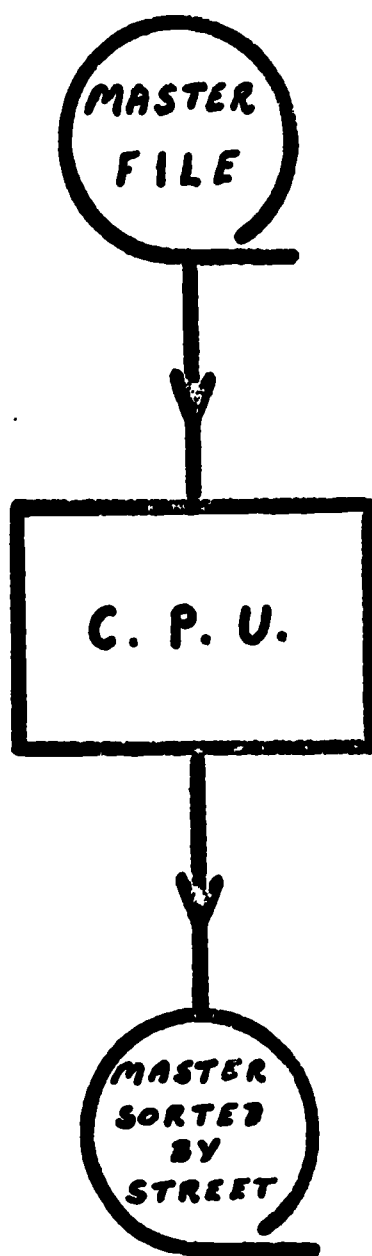
10. — 3523

YOUR COUNTY  
UPDATE REGISTER

DISTRICT	NAME & ADDRESS	PARTY	SEX	NUMBER	LAST VOTE	ACTION
1-13-02-1	RICHARD SMITH 39 MAIN STREET YOURTOWN	R	M	107532	G 66	DELETE
1-13-03-2	JANET JONES 25 VINE STREET MYTOWN	D	F	234567		ADDITION
2-36-02-1	MOLLY MAGUIRE 75 ASH STREET OURTOWN	R	F	376245	G 66	OLD DATA
	56 PENN STREET	D				CHANGED DATA
3-68-04-5	TOM JONES 408 CHURCH STREET OURTOWN	R	M	398541		ADDITION

INPUT RECORDS	195,075	
CHANGES		10,500
ADDITIONS	5,025	
DELETIONS	1,500	
OUTPUT RECORDS	198,600	

STREET LIST SORT



**PURPOSE:**

To arrange the master file of voters by street within voting district.

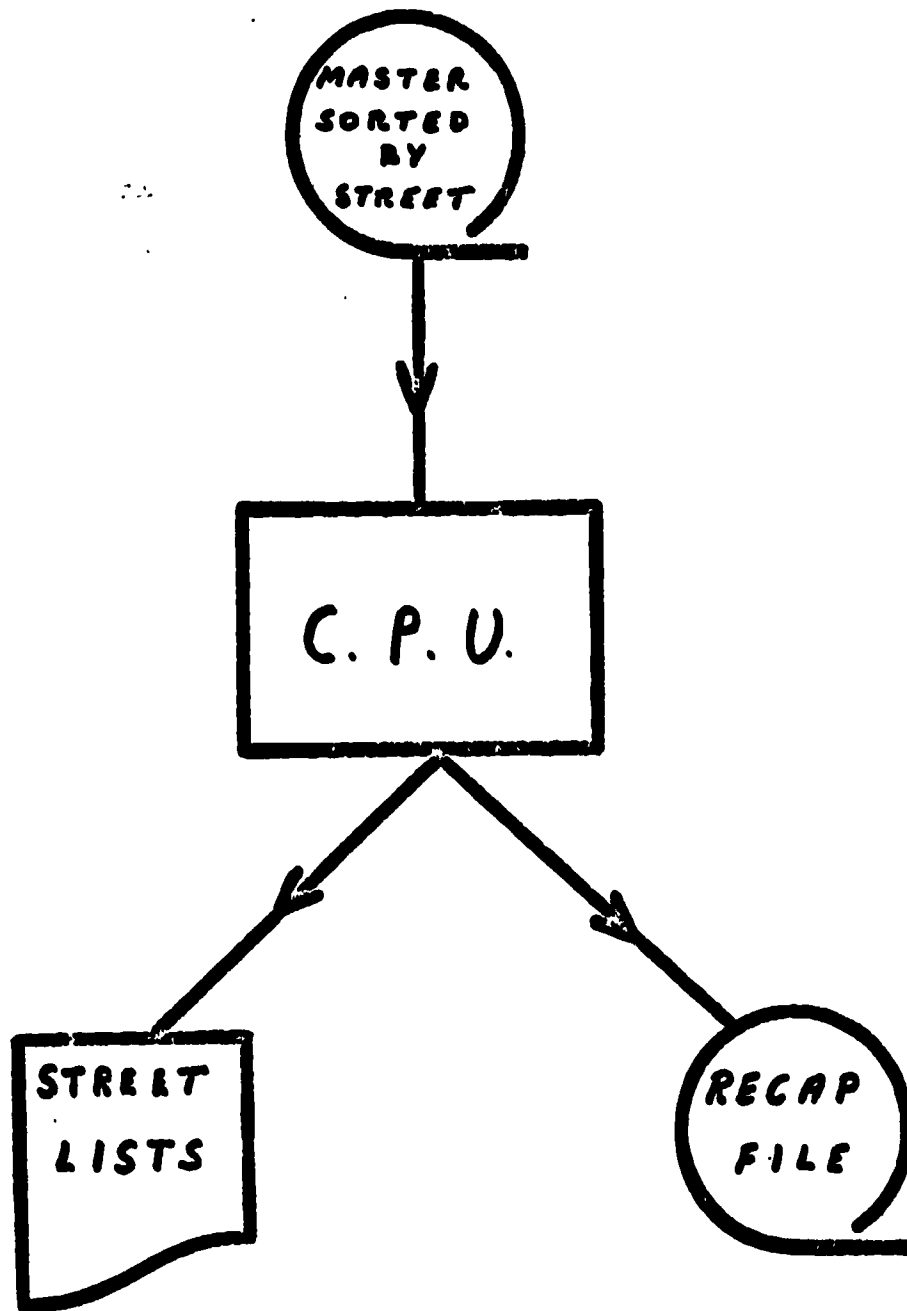
STREET LIST SORT

This sort will arrange the file in the proper format to produce the street list. The fields which must be sorted are:

1. Voting district
2. Record code
3. Street number
4. Street name
5. Voter's last name

By also sorting the voter name, those individuals living in apartment complexes and rural areas will also appear alphabetically under a common address.

STREET LISTS



**PURPOSE:**

To prepare a complete list of voters by street within each voting district.



STREET LISTS

The run will create a list of voters, by street, within voting district. The lists will contain the name, address and party affiliation of each voter. At the end of each voting district totals will be printed showing party affiliation only.

These lists must be available for distribution to the candidates and local committeemen ten (10) days prior to election day. This run must therefore be made early enough to allow sufficient time to prepare copies of the lists for distribution.

During the run the total records are written onto another file to be used later in producing registration recap totals.

YOUR COUNTY

DATE

STREET LIST

PAGE NO.

(VOTING DISTRICT IDENTITY)

PARTY	NAME	ADDRESS	IDENT. #
R	JOHN DOE	23 MAIN STREET	264890
D	MARY SMITH	27 MAIN STREET	126386
D	JOHN Q PUBLIC	35 OAK STREET	735269
I	RICHARD MAKEBELIEVE	37 OAK STREET	234567
R	MARY ANN JONES	97 PENNSYLVANIA AVE	765864

REPUBLICAN

DEMOCRAT

OTHER

TOTAL

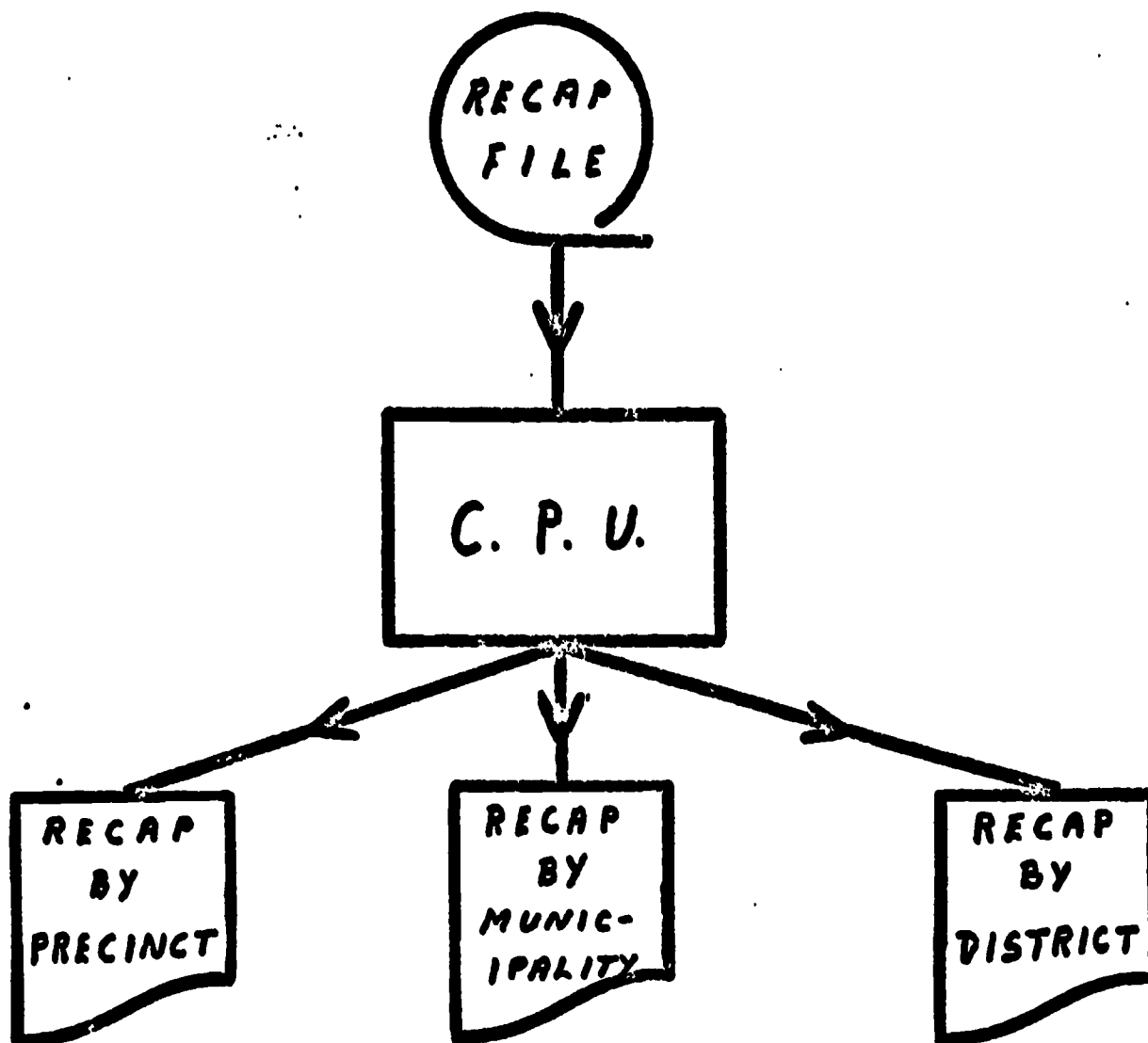
276

325

49

650

REGISTRATION RECAP



**PURPOSE:**

To prepare the totals of voters registered by party and sex in three different arrangements:

1. By precinct
2. By municipality
3. By district

### REGISTRATION RECAP

Using the recap file created during the street list run, this three pass run will produce the following recaps:

1. By precinct

The totals by party, sex, and a grand total will be shown for each individual precinct, starting each municipality on a separate page.

2. By municipality

The same totals will be shown on one line for each municipality. Each district will start on a new page.

3. By district

The same totals will again be shown, but now there will be only one line for each district and the report will be contained on one page.

These recaps will be made on either multiple-part paper or on reproducible masters, depending on the number of copies required by the registration departments.

YOUR COUNTY

RECAP BY PRECINCT

MUNICIPALITY NAME

WARD	PREC.	REPUBLICAN		DEMOCRAT		OTHER		TOTAL	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
01	1	75	52	98	46	15	9	188	106
01	2	108	97	276	198	23	19	407	314
02	1	209	176	163	257	10	6	382	439
03	1	186	127	293	265	5	1	489	403

FORMAT 1 EACH MUNICIPALITY ON A SEPARATE SHEET

YOUR COUNTY

RECAP BY MUNICIPALITY

DISTRICT #

MUNICIPALITY	REPUBLICAN		DEMOCRAT		OTHER		TOTAL	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
YOURTOWN	987	869	760	586	65	23	1,812	1,478
MYTOWN	1,658	968	1,675	1,432	1	0	3,334	2,400
OURTOWN	2,537	1,860	1,548	1,226	21	9	4,106	3,095

FORMAT 2 EACH DISTRICT ON A SEPARATE SHEET

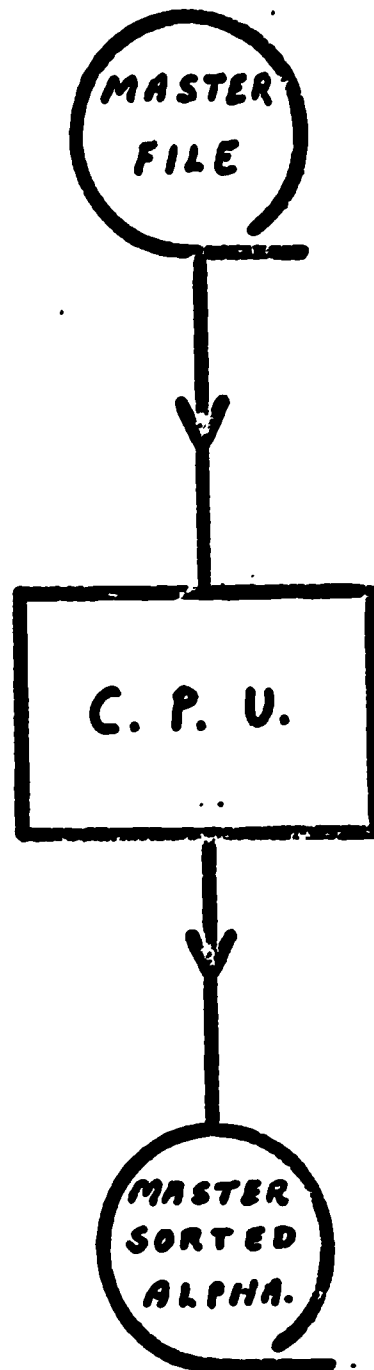
YOUR COUNTY

RECAP BY DISTRICT

DISTRICT	REPUBLICAN		DEMOCRAT		OTHER		TOTAL	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
FIRST	9,864	7,609	10,533	10,432	138	34	20,585	18,075
SECOND	14,759	15,733	18,630	17,581	13	8	33,402	13,327
THIRD								
FOURTH								
FIFTH								
SIXTH								
TOTAL	45,862	30,791	52,196	45,789	1,135	863	99,193	77,443

FORMAT 3 REQUIRES ONLY ONE SHEET

SORT FOR CERTIFICATES



**PURPOSE:**

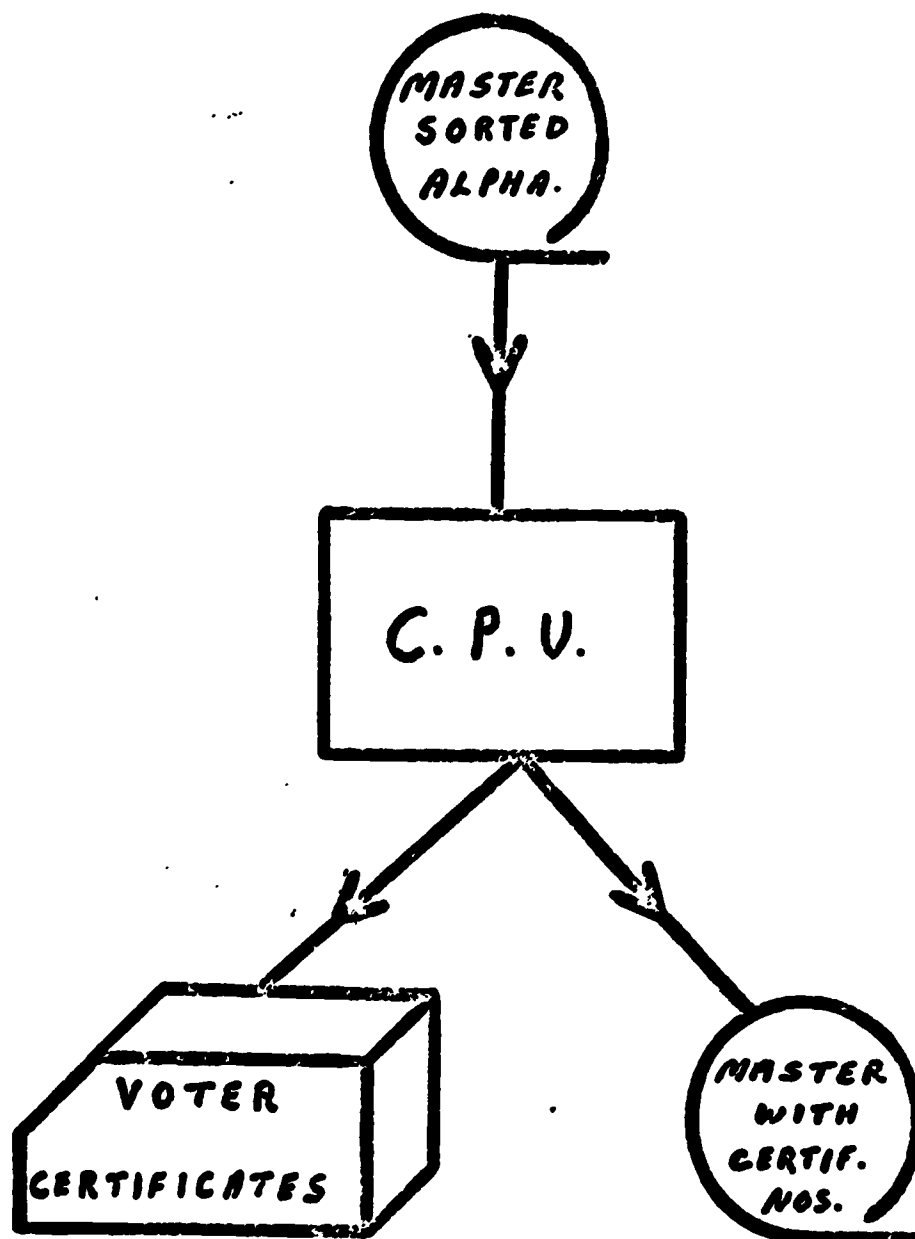
To arrange the master file of voters alphabetically by last name within voting district.

**SORT FOR CERTIFICATES**

This sort will arrange the file in alphabetical order within voting districts in order to prepare the voter certificates. The fields to be used in this sort are:

1. District, municipality, ward, and precinct.
2. Record code (voters and total records)
3. Voter last name
4. Voter first name
5. Voter initial

CERTIFICATE RUN



**PURPOSE:**

To prepare the voter certificate cards which must be signed by the voter before he casts his ballot.



CERTIFICATE RUN

This run will produce on pre-numbered cards, voting certificates for each individual voter. Each certificate will require the following data on it:

1. Complete name and address
2. Voting district
3. Party affiliation
4. Date of election

A header card will be used containing the date of the election and the starting certificate number. As each certificate is produced, its assigned number is written into the space provided on the master record. This number will be used in a later run to update the date of last voting in each record.

At the conclusion of the run the following data will be printed:

1. Number of records read
2. Number of records written
3. Starting and ending certificate numbers
4. Total number certificates produced.

YOUR COUNTY  
VOTER CERTIFICATE CARD

NAME

ADDRESS

WARD PREC.

PARTY

MUNICIPALITY

107956

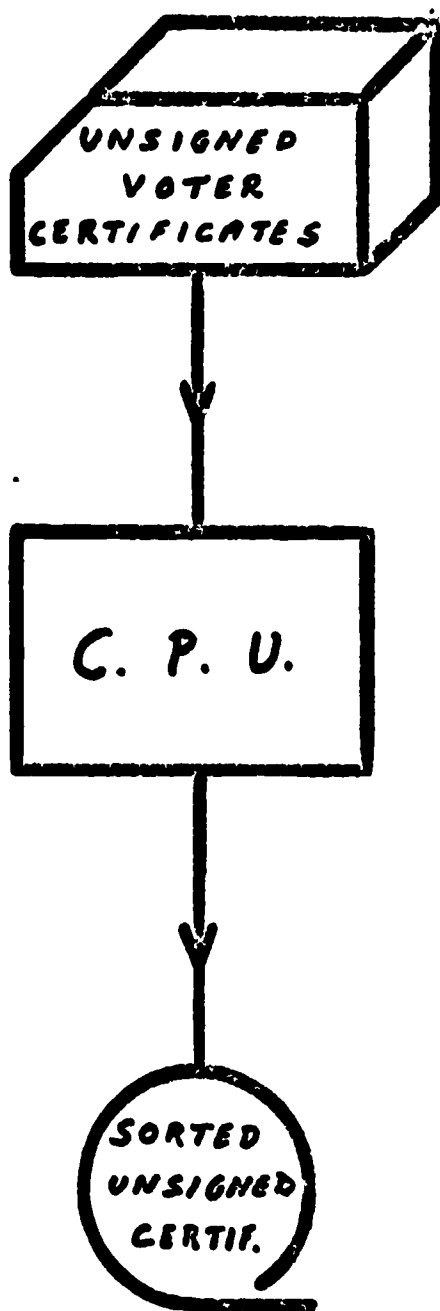
• LEGEND

VOTER

ELECTION CLERK

CARDS ARE PRENUMBERED AND A CARD IS PREPARED FOR EACH REGISTERED VOTER

SORT OF UNSIGNED VOTER CERTIFICATES



**PURPOSE:**

To convert the unsigned voter certificates to tape and sort in certificate number sequence.

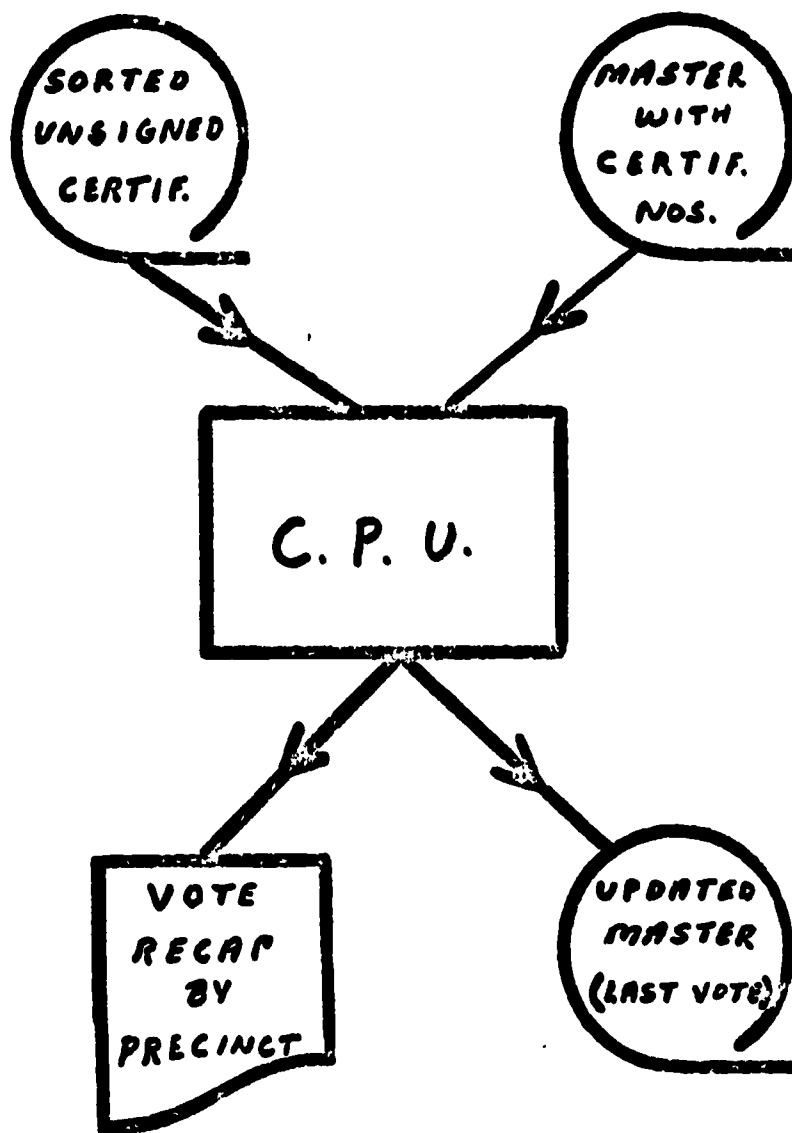
### SORT OF UNSIGNED VOTER CERTIFICATES

After the election is official, the signed certificates are stored as a permanent record and the unsigned cards are returned to the data processing department for file updating. The certificates are run as input to the sort, and the output is a tape file of the unsigned certificate numbers. This file will be used as input to the Voting Data Update run.

The unsigned cards are used because:

1. The signed cards are a permanent record
2. The volume will be smaller and result in faster processing.

VOTING DATA UPDATE



**PURPOSE:**

To update the master file assigning the date of the current election to the last-voting-date field of those who voted in the current election.

VOTING DATA UPDATE

This run will insert the current election code into all records for which no unsigned card has been returned. The code is made up of three digits, the first being a P to indicate primary election or G to indicate a general election. The last two (2) digits are the year in which the election is held i.e., (G68)

As the records are updated, the assigned certificate number is blanked out. At the end of each voting district, totals are printed showing:

1. Registration by party and sex.
2. Actual votes by party and sex.
3. Percentages.

YOUR COUNTY .

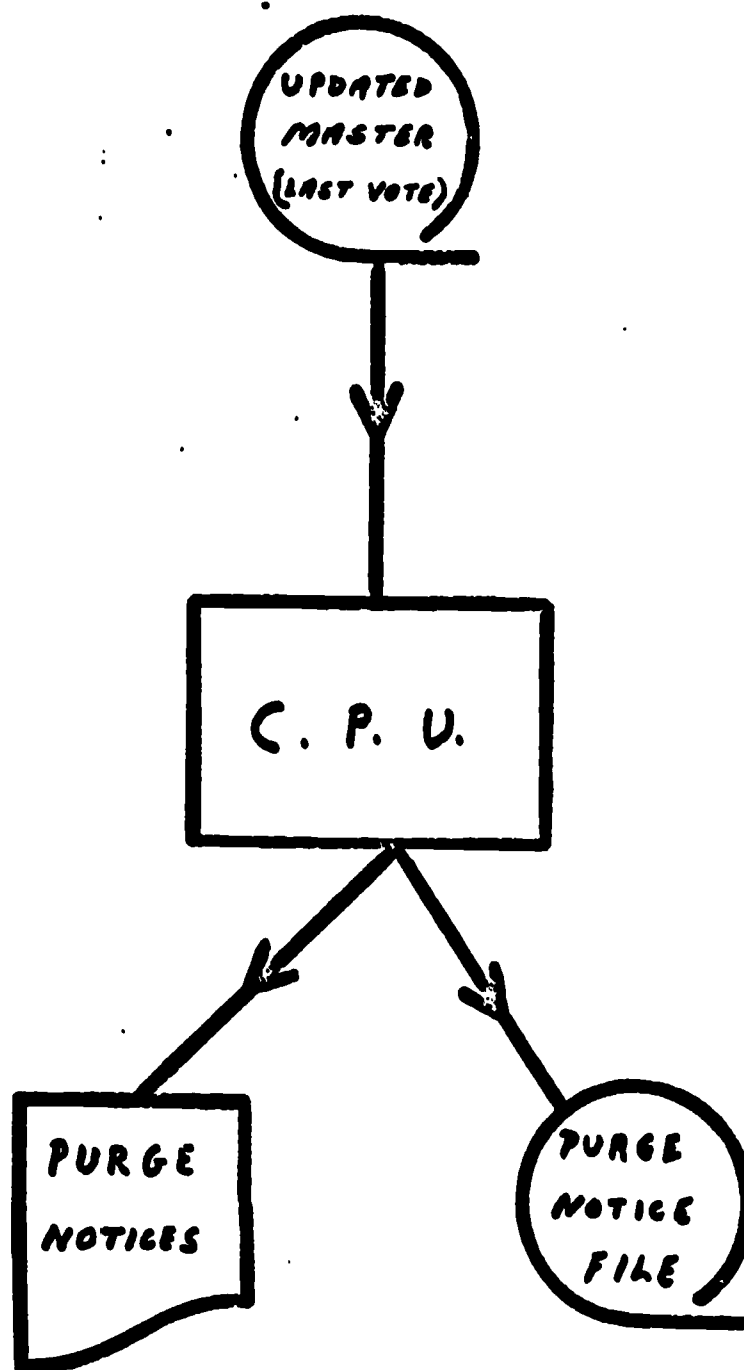
VOTE RECAP BY PRECINCT

MUNICIPALITY NAME

WARD PREC.	REPUBLICAN		DEMOCRAT		OTHER		TOTAL		
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	
01 01	REGISTERED	100	98	210	245	10	2	320	345
	VOTED	80	72	195	160	10	1	255	233
	%	80%	73%	93%	65%	100%	50%	89%	68%
01 02	REGISTERED	98	72	130	102	5	1	233	175
	VOTED	90	53	100	95	4	0	194	148
	%	92%	74%	77%	93%	80%	0%	83%	85%
GRAND TOTAL	REGISTERED	5,862	6791	5196	4789	135	63	11193	11643
	VOTED	3,810	4821	4260	3495	66	59	8136	8375
	%	65%	71%	82%	73%	49%	95%	73%	72%

EACH MUNICIPALITY STARTS ON A NEW SHEET

PURGE NOTICE RUN



**PURPOSE:**

To prepare notices of impending purge from the file of all those who have not voted in the last five (5) consecutive elections.



**PURGE NOTICE RUN**

This run checks the last voting-date of each record. If a voter has not voted in five (5) consecutive elections a notice of purge is prepared. These notices are two-part post cards which contain the complete detail of the voter. Also printed on the notice will be a date by which the voter should sign and return the card if he wishes to be reinstated on the file.

As a notice is prepared, the record is written onto another tape to create the purge file which will be used in the actual purge run.

**NOTICE FOR PURGE AND REINSTATEMENT**

**(CUT OUT)**

**LEGEND OF PURGE AND REINSTATEMENT**

**VOTING DISTRICT**

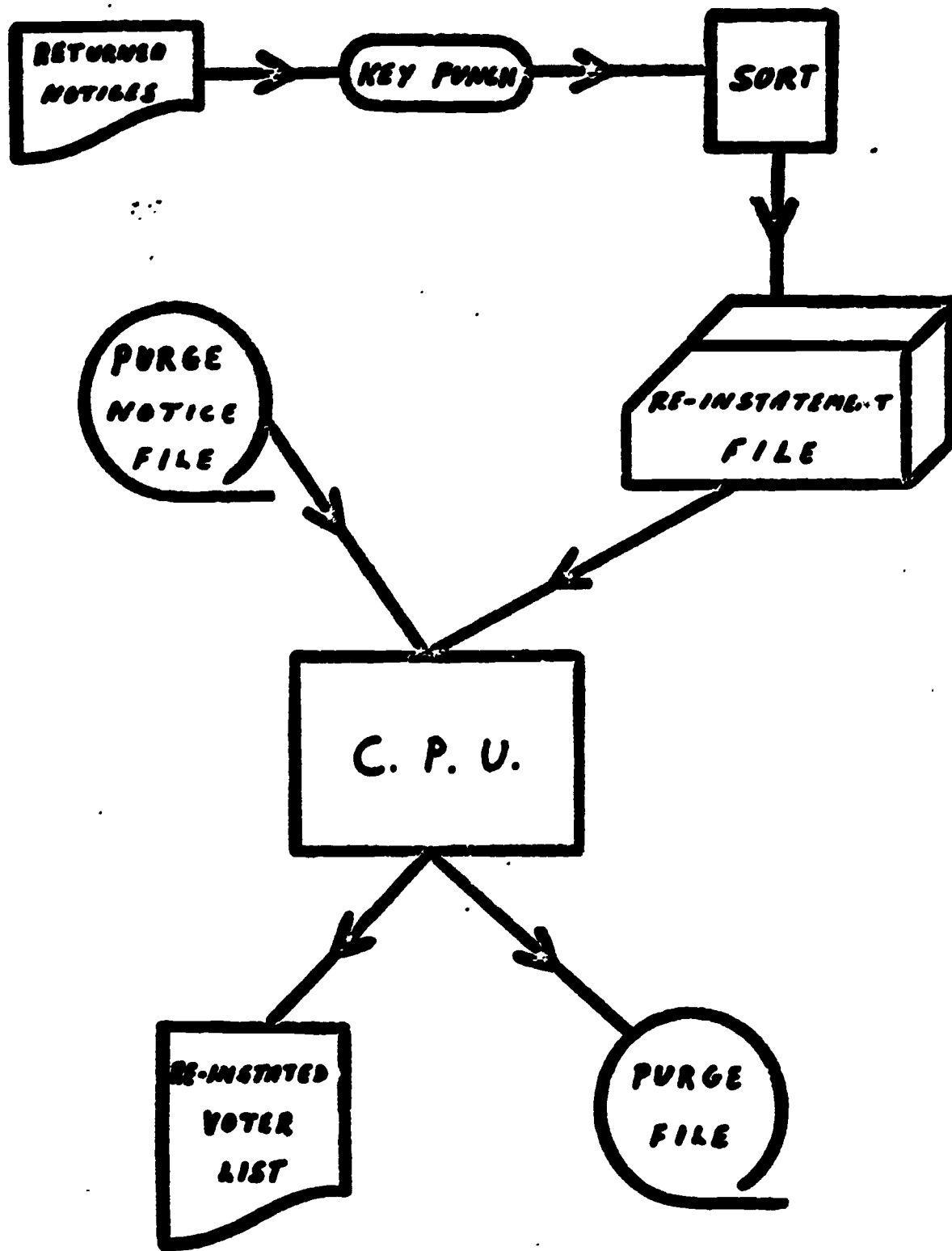
**LAST VOTED**

**RETURN DATE**

**NAME AND ADDRESS**

**SIGNATURE**

REINSTATEMENT RUN



**PURPOSE:**

To eliminate from the purge file those who have indicated a desire to remain on the registration roles by returning the purge notice properly signed.

**REINSTATEMENT RUN**

The cards which have been properly signed and returned for reinstatement to the file are now passed against the purge file. When a card matches a record on the purge file, the last voting date is changed to the current election code and year. A register is also produced showing the complete detail of each voter who is being reinstated. At the end of the run totals will be printed showing the total of reinstatements and the number to be purged.

# Layout Form - 80 Column Card

R	X	POSITION	W	IDENTIFICATION NUMBER
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Title REINSTATEMENT CARD

Prepared By For Program

By Programmer Checked By

Date Remarks

Modification Page Of

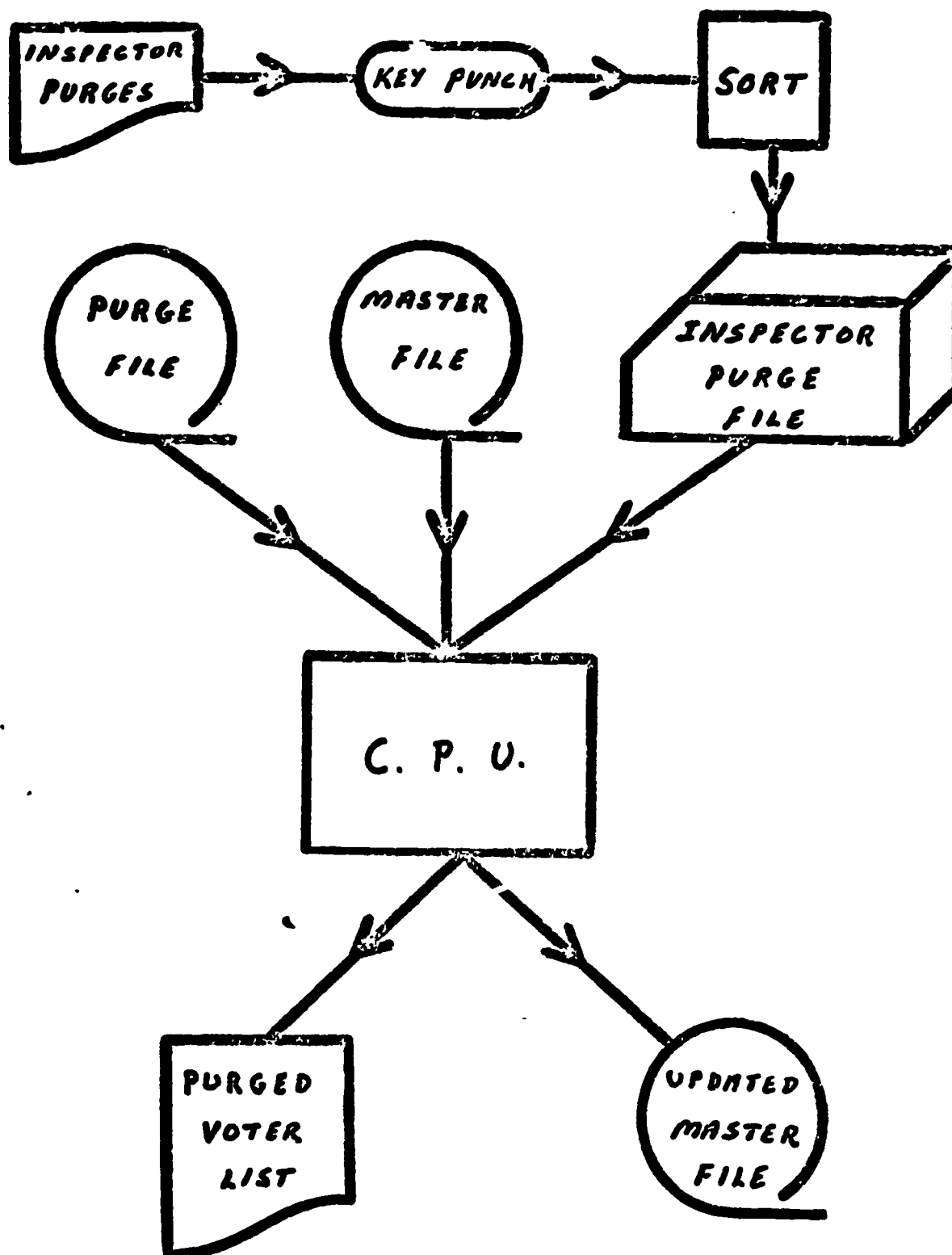
YOUR COUNTY  
REINSTATED VOTERS LIST

DISTRICT	NAME	ADDRESS	NUMBER	PARTY
1-12-01-1	JOHN SMITH	109 MAIN STREET	367298	D
2-34-03-4	MARY BROWN	78 OAK STREET	839275	R
2-46-07-1	PAUL DOE	212 PENN STREET	923847	R
3-62-01-3	SAM JONES	7 RACE STREET	148206	D

VOTERS REINSTATED 372

VOTERS TO BE PURGED 793

PURGE OR FINAL UPDATE



**PURPOSE:**

To bring the master to current status by purging from the file those who did not return their notices, and also those voters the inspector has indicated no longer should be kept on the file.

PURGE OR FINAL UPDATE

In this run the purge file and any inspector purge cards are matched against the master file. The records that were changed for rein-statement are adjusted on the master. All others on the purge file are omitted from the master at this point. A register will be produced showing the complete detail of each record being purged and the reason for the purge. Most purges will be for not voting in the last five (5) consecutive elections; the remainder will be the purges that have been initiated by the district voting inspectors. The inspector will purge for the following reasons:

1. Deceased (or declared legally dead)
2. Declared legally incompetent
3. Committed to penal institution
4. Committed to a mental institution
5. Moved away from the area.



IDENTIFICATION NUMBER	2381000000
DATE	10-10-68
TIME	10-10-68
BY	XX

**INSPECTORS PURGE CARD**

Continued on Page \_\_\_\_\_  
For Program \_\_\_\_\_

Checked By: \_\_\_\_\_

Remarks \_\_\_\_\_

COLUMN 13 CONTAINS THE CODED REASON FOR BEING PURGED.

**Modification**

Page \_\_\_\_\_ Of \_\_\_\_\_

YOUR COUNTY

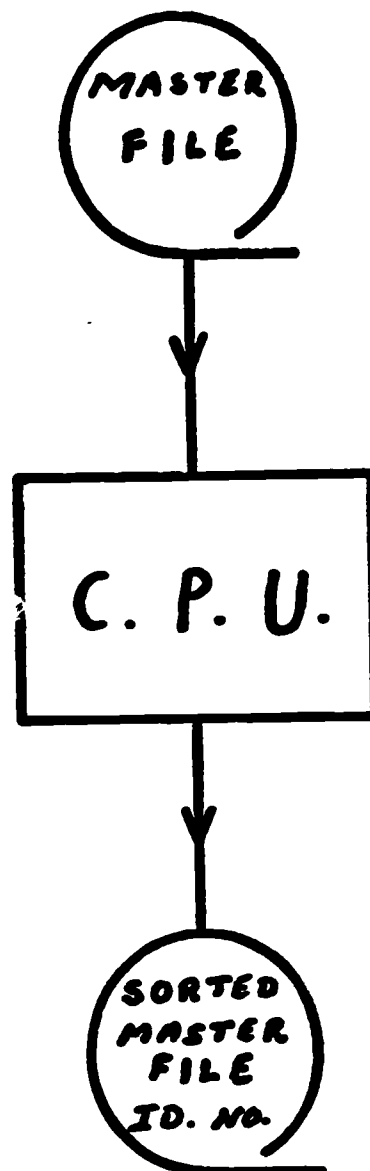
PURGE LIST

DISTRICT	NAME	ADDRESS		PARTY	REASON
1-13-02-6	JOHN DOE	72 ASH STREET	246391	D	2
1-18-08-1	PETER JONES	22 VINE STREET	100650	R	4
2-35-02-1	MARY SMITH	77 MAIN AVE	222543	R	1

LEGEND OF REASON CODES USED IN PURGING

- |                                      |                                    |
|--------------------------------------|------------------------------------|
| 1. NOT VOTING IN LAST FIVE ELECTIONS | 4. LEGALLY INCOMPETENT             |
| 2. MOVED OUT OF AREA                 | 5. COMMITTED TO PENAL INSTITUTION  |
| 3. DECEASED                          | 6. COMMITTED TO MENTAL INSTITUTION |

SORT  $\frac{M_1}{T_1}$



**PURPOSE:**

To arrange the master file of voters by identification number within voting district.

**SORT #4**

The file is sorted by identification number within voting district.  
This will put the file into the proper sequence to start the cycle  
again for the next election.

**PRACTICAL APPLICATIONS IN INDUSTRY**

**Suggested Time:** Nine hours

**Description:** This section presents case studies of selected applications that are currently being used in the field of data processing.

**Major Divisions:**

**I. CASE STUDIES**

**II. OTHER APPLICATIONS**

**Objective:**

To present general applications used by industry to supply the current information required by management, to make sound decisions. Class discussion of the case studies and other typical applications mentioned will help to develop a broad realization of the capabilities and functions of data processing in industry.

Case studies contain sufficient information to be used in laboratory exercises.

### CASE STUDY A - SALES STATISTICS

One of the most common and important types of reporting generated by a data processing department is the analysis of sales statistics. The sales department is interested in the performance of product lines in general, in comparison to the same interval last year, and forecasted sales. They use this information in directing and determining salesmen quotas, product quantity requirements (inventory), product modification, and adjusting of forecasts. The production department needs sales information to prepare for future demands. The advertising section will be able to determine the effectiveness of their campaign and the direction of future emphasis. Management uses this information in determining the profitability of product lines and as a guide in the direction of continuing company effort.

Analysis by product is not the only method of presentation. The same data reorganized will present the performance of individual salesman, of branch offices and/or territorial districts. The figures can be compared to past performance and forecasted sales. A further reorganization will allow for an analysis to be prepared by customer.

Company A prepares a card for every sale during the month by each sales representative. Each card contains the following:

1. Product identification number
2. Quantity of the sale
3. Salesman identification number
4. Number of the territory to which the salesman is assigned

From these cards, two (2) reports are requested. The Current Sales Report which presents:

1. Current month's sales of each product
2. This month-last year sales of each product
3. Current year-to-date total sales of each product
4. This month-last year-to-date sales of each product.

The Salesman and Territory report which presents

1. Total months sales by each salesman within territory
2. Total sales produced by each territory
3. Grand total of company sales for the month.

The master record of each product contains:

1. Product identification number
2. Unit price
3. Current year-to-date total
4. This month-last year-to-date this month

It is maintained in products number sequence, using indexed sequential file organization.

To prepare the first report, the cards are sorted by product number and then matched against the master file. As the report is being prepared the year-to-date figures in the master are updated and a transaction file is prepared containing extended figures of unit price times quantity. Figure 1 is a sample of how this report may appear.

To prepare the second report, the transaction file with extended figures will be sorted by salesman within territory. The product is not relevant to this report. The report is produced listing the total for each salesman and each district with a final company total.

Figure 3 is a systems flow chart presenting the complete procedure.



COMPANY A

REPORT 1

PAGE NO.

DATE	CURRENT SALES REPORT				YEAR TO DATE LAST YEAR
	PRODUCT CODE	SALE THIS MONTH	THIS MONTH LAST YEAR	SALES THIS YEAR	
	12783	100.75	95.50	1,782.00	1,750.00
	13902	1,529.00	1,759.00	6,750.00	7,277.25
	13951	22.50	45.75	351.00	400.00
	14001	751.00	650.00	2,100.00	2,175.00
	15709	329.50	325.00	932.00	1,432.00
	15999	2,573.00	2,400.00	10,295.00	8,979.50
	16324	925.00	1,050.00	1,532.00	1,725.00
	GRAND TOTALS	29,272.75	26,325.25	175,690.00	1,784,738.75

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FIGURE 1 - SALES BY PRODUCT THIS MONTH AND YEAR TO DATE

COMPANY A

DATE XX/XX/XX .

REPORT 2

PAGE NO.

SALESMAN AND TERRITORY REPORT

	SALESMAN	TERRITORY	TOTAL.
102	1,500.00	1	
115	975.00	1	
122	1,050.00	1	
		1	3,525.00
210	750.00	2	
220	490.00	2	
230	825.00	2	
		2	2,065.00
900	1,570.50	9	
905	572.00	9	
915	635.00	9	2,777.50
GRAND TOTAL			29,272.75

FIGURE 2 - REPORT BY SALESMAN WITHIN TERRITORY

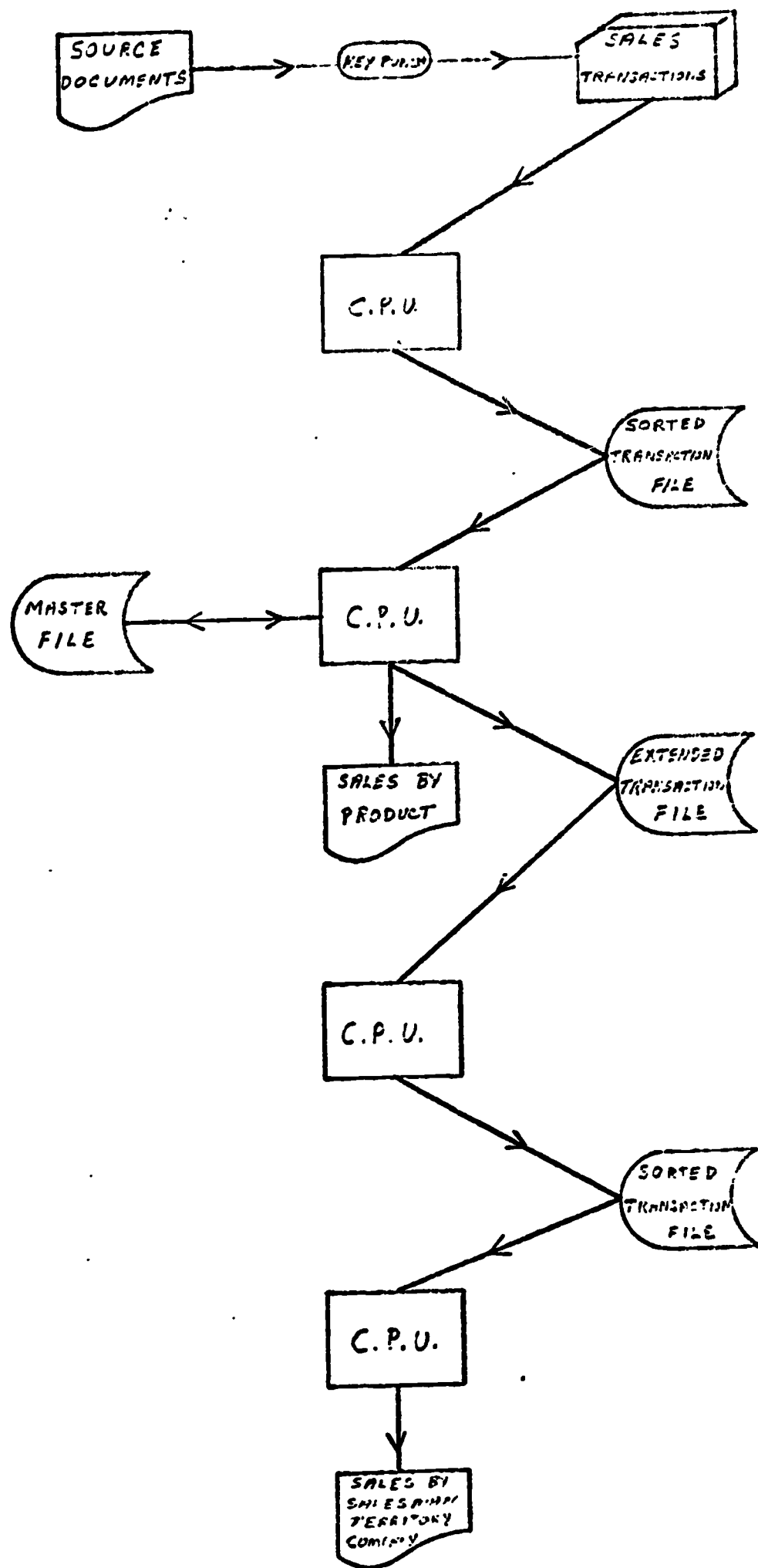


FIGURE 3 - COMPANY A's PROCEDURE TO PRODUCE ITS REQUIRED SALES REPORTS.

### CASE STUDY B - INVENTORY CONTROL

It is important to a company to have current and precise information about its inventory. The supply of raw materials, work-in-process, and finished products often represents the company's chief investment.

To maintain an oversupply in the stockrooms will result in unnecessary binding of working capital, and will also result in a costly waste of valuable storage space, and additional protection which must be provided.

Insufficient supplies may result in loss of income due to loss of sales, shipment delays which might result in higher shipping cost, and necessitate overtime to meet backlogged orders.

The aim of inventory control is to balance overstocking against understocking, by keeping track of and analyzing the quantities on hand and on-order against quantities required by sales forecasting. From this analysis the re-order point and the quantity to be ordered can be determined. The following day-to-day procedure will control some of the routine decisions (i.e., when to order and how much) and provide management with inventory statistics necessary to assist in company decisions.

Case study B presents a basic system of inventory control.

The nature and complexity of industry will in many cases require a more sophisticated and expanded system of inventory control. Some other areas linked to inventory are:

1. Determination and allocation of equipment, labor and material
2. Scheduling of production and delivery
3. Analysis of labor and material expenditure
4. Calculation of direct and indirect cost to establish prices, and maintain profits
5. Project changes and trends in market strength and demands.

Some other areas which are part of every system but not presented, in the study are:

1. File maintenance for additions, deletions, and adjustments.
2. Month and year-to-date histories
3. Analysis of fast and slow moving products (market analysis).

Company B, a distributor, processes inventory daily and produces two (2) reports

1. Inventory Status Report shows the available stock, shipment demands, re-order point, shipped today and maximum order quantities. This reflects all stock on hand.
2. Today's shipments showing what was shipped today and the new balance.

The master file in ascending part number sequence contains the following:

1. Product code
2. Quantity on hand
3. Quantity on order
4. Economic order quantity
5. Maximum order quantity
6. Reserved for shipment
7. Unit price

Two types of transactions are used in this process:

1. Today's shipments reduce the quantity on hand
2. Today's sales increase reserved-for-shipment but do not actually reduce quantity on hand

A card is prepared for each transaction containing:

1. Transaction code
2. Product code
3. Quantity shipped or ordered

Before processing, the transactions are sorted by product code. As the transactions are matched against the master, the on hand or reserved for shipment field is updated and listing of all shipments is printed (Figure 1). The updated master file is then processed to produce the inventory status report (Figure 2). This report supplies management with the current position of each product in stock and indicates which items should be replenished. Figure 3 is a system flow of the procedure in preparing these reports.

**COMPANY B**  
**INVENTORY SHIPMENT REPORT**

**DATE XX/XX/XX**

**PAGE NO.**

<b>PRODUCT</b>	<b>IN STOCK</b>	<b>ISSUED</b>	<b>NEW BALANCE</b>
<b>72</b>	<b>5720</b>	<b>475</b>	<b>5245</b>
<b>107</b>	<b>4500</b>	<b>1000</b>	<b>3500</b>
<b>120</b>	<b>580</b>	<b>25</b>	<b>555</b>
<b>150</b>	<b>321</b>	<b>75</b>	<b>246</b>
<b>275</b>	<b>1793</b>	<b>250</b>	<b>1543</b>
<b>310</b>	<b>620</b>	<b>35</b>	<b>585</b>

**FIGURE 1 - REPORT OF TODAY'S SHIPMENTS**



COMPANY B INVENTORY STATUS

DATE	PRODUCT	ON HAND	RES. FOR SHIP	AVAILABLE STOCK	RE-ORDER POINT	ON ORDER	PAGE NO.	MAX. QUANT. TO ORDER
101		3500	1500	2000	2000	-0-	7500	
102		1750	25	1725	750	-0-	2500	
103		4500	500	4000	5000	10000	15000	
104		500	-0-	500	100	-0-	1500	
105		790	100	690	400	-0-	2750	
106		329	-0-	329	50	-0-	500	
107		1147	250	897	500	250	2500	
108		128	28	100	100	500	500	

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FIGURE 2 - STATUS OF ALL PRODUCTS IN STOCK

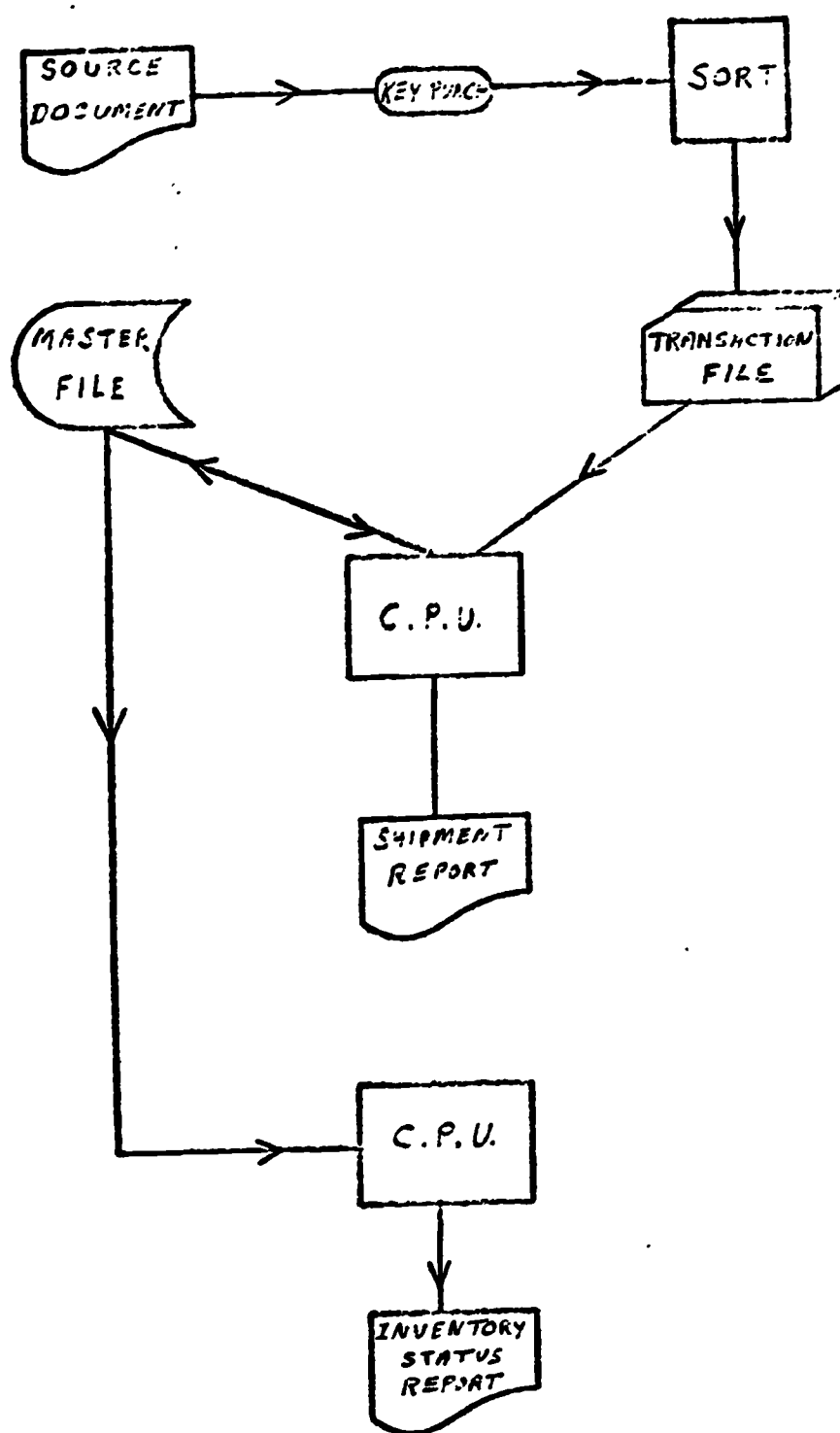


FIGURE 3 - DAILY INVENTORY PROCESSING OF COMPANY B

### CASE STUDY C - PAYROLL

A standard data processing application is payroll. The fundamental concept of payroll sounds very simple; a time card showing the hours each employee has worked and a master file containing his rate and accumulated totals are supplied, then his check is calculated and printed and the totals are updated. In actuality, payroll is not as simple as it sounds. Many other factors are considered.

Corporations need to know the cost allocation of multiple operations an employee may have performed during the pay period. When time-by-operation information is supplied, this distribution report becomes a routine by-product of the payroll operation.

There must be provisions to handle the varied deductions, taking into consideration that in some instances, the gross pay of the employee may not be sufficient to handle all the deductions.

The master file must be kept up-to-date with many changes in order to accurately and efficiently perform payroll processing. Some of these changes are:

1. Pay rate
2. Marital status
3. Number of dependents
4. New, deleted, and adjusted deductions
5. Adjustments for prior errors
6. New employees
7. Deleted employees.

Master file totals must be updated each pay period to maintain the figures needed to prepare the quarterly and yearly reports required by government agencies. i.e., 941 report of quarterly earnings, and W-2 with-holding tax statements.

Piecework or incentive payroll, where the employee is paid for the amount of work performed rather than the hours worked, can be a very complex procedure.

The system may also be required to handle personnel that are paid on a salary basis instead of time or incentive. A few of the areas that may also be provided for are:

1. Retirement plans
2. Accrual of sick leave and vacation pay

Payroll processing results in a wide variety of reports which serve as documentation of all actions taken and allow for auditing the accuracy of the work. They range from basic payroll registers to detailed cost distribution and personnel performance reports.

In the study which follows, Company C is a manufacturing firm paying weekly through the previous Friday. Personnel are paid on incentive, time, and salary basis. Cost and labor distribution reports are prepared but will not be reviewed in this case. It is assumed that the necessary master file changes have been made and documented, and that calculations to develop gross pay have been executed, properly documented, and an earnings file created.

Company C, using the earning file, is ready to produce the employee pay checks. As the earnings file is matched against the master file, necessary tax calculations are performed, individual deductions are taken to develop the net pay, and quarterly and yearly totals are updated with the current pay. The output of this run is:

1. Properly updated master file. The figures updated are:

- A. Gross earnings
- B. Taxes
- C. Deductions
- D.. Time worked
- E. Incentive earnings

2. Payroll Register

3. Check file

Each employee is listed on the payroll register (Figure 1) which shows:

- 1. Employee number
- 2. Employee name
- 3. Department number
- 4. Gross pay
- 5. With-holding tax
- 6. F.I.C.A. tax
- 7. Other deductions
- 8. Net pay
- 9. Check number which is assigned at this time
- 10. Departmental and company totals.

At the same time, this information is written to the check file along with year-to-date figures.

The check file is now used to produce the individual payroll checks. Figure 2 illustrates the payroll check.

The master file and earnings file are used during later runs to produce personnel performance and cost distribution reports.

Figure 3 is a system flow chart of Company C's payroll procedure.

## COMPANY C

DATE XX/XX/XX		PAYROLL REGISTER				PERIOD ENDING XX/XX/XX						
EMP. #		DEPT. #	GROSS	WH/T	FICA	HOSP.	UNION	DUES	XMAS CLUB	UNITED FUND	NET	CHECK #
101	JOHN L SMITH	01	150.25	21.03	6.60	5.61	.75	.75	2.00	1.50	112.76	1597
102	HORACE F GREELY	01	172.50	24.32	7.62	5.61	.75	.75	2.00	1.00	131.20	1598
103	SUSAN N SLADE	01	135.10	18.90	6.08	6.29	.75	.75	5.00	.75	97.33	1599
104	GERALDINE A CHAPLIN	01	142.50	19.31	6.25	5.61	.75	.75	1.00	1.25	108.33	1600
105	HARVEY M DIXON	01	165.00	22.73	7.26	6.29	.75	.75		1.50	126.47	1601
DEPT. TOTAL		01	765.35	106.29	33.81	29.41	3.75	3.75	10.00	6.00	576.09	
GRAND TOTAL			14,729.50	1,869.30	583.10	329.15	75.00	75.00	235.00	175.50	11,462.45	

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FIGURE 1- PAYROLL REGISTER

NAME JOHN Q. PUBLIC DEPT. 12 SOCIAL SECURITY # 193-30-2034 DATE 2/15/69 PERIOD ENDING 2/08/69

REG. HOURS	REG. RATE	REG. EARN.	O. T. HOURS	O. T. RATE	O. T. EARN.	GROSS EARN.
40.0	4.00	160.00	10.0	6.00	60.00	220.00

W/H	F.I.C.A.	CITY TAX	HOSP.	UNION	XMAS	CR. UNION	OTHER	TOT. DED.
35.20	9.68	2.20	19.50	1.00	2.00	5.00	.50	75.08

YTD GROSS	YTD W/H	YTD F.I.C.A.	YTD CITY TAX
1600.00	352.00	70.40	16.00

NET PAY
144.92

COMPANY C  
100 ANY STREET  
YOUR TOWN, U.S.A.

PAYROLL ACCOUNT

23-735  
419

PAY TO THE ORDER OF JOHN Q. PUBLIC EXACTLY \$\*\*\*\*\*144.92

FIRST NATIONAL BANK OF YOUR TOWN  
500 MAIN STREET  
YOUR TOWN, U.S.A.

TREASURER

FIGURE 2 - PAYROLL CHECK



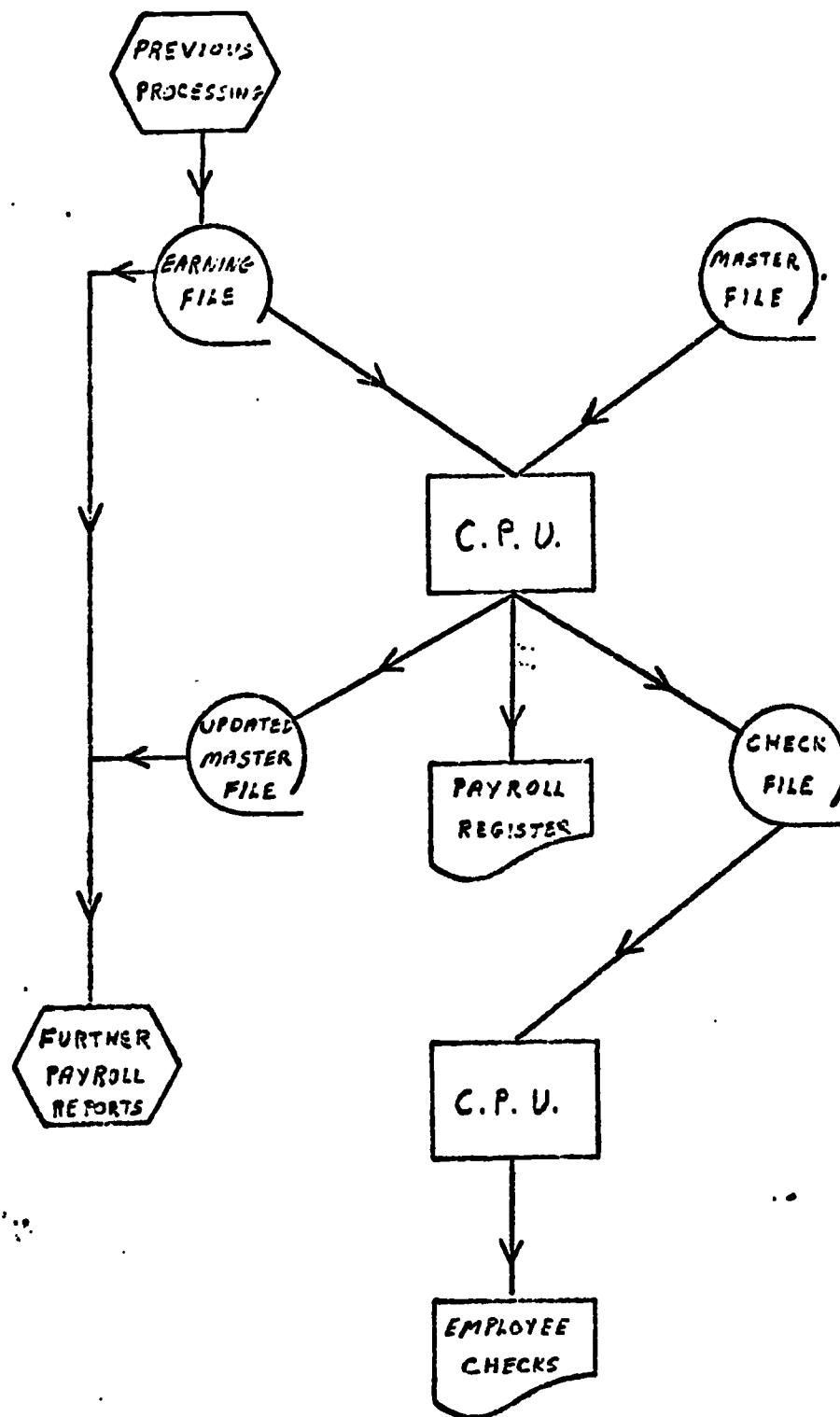


FIGURE 3 - SEGMENT OF COMPANY C's PAYROLL SYSTEM.

## II. OTHER APPLICATIONS

### A. Banking

1. Demand deposit accounting
2. Savings accounting
3. Mortgage and commercial loans
4. Installment loans

### B. Publishing and Printing

1. Automatic typesetting
2. Printing scheduling

### C. Manufacturing

1. Accounts receivable and Accounts payable
2. Labor and cost distribution and analysis
3. Production scheduling
4. Analysis of market and season trends
5. Credit reporting

### D. Trucking service

1. Truck routing schedules
2. Vehicle maintenance scheduling
3. Vehicle cost reporting

PRACTICAL APPLICATIONS IN SCHOOL ADMINISTRATION

**Suggested Time:** Nine hours

**Description:** Case studies in school administration where data processing has been effectively put to use.

**Major Divisions:**

I. CASE STUDIES

II. OTHER APPLICATIONS

**Objective:**

To develop an insight to areas where data processing has been applied successfully to school administration in the never ending process of improving our educational system. It is hoped that by class discussions of problems in these familiar areas the participant will develop an appreciation of data processing as a helpful tool. Class exercises on file design, record layouts, and flow charting, based on the detail of the case studies, may be included.

### CASE STUDY A - ATTENDANCE ACCOUNTING

This system is for the collection and reporting of student attendance data. At the beginning of every marking period, attendance cards are prepared for each student. Homeroom teachers mark sense absences daily and forward the cards to the data processing department where the mark sensing is transcribed to punched holes. The cards are transferred to tape, creating a daily attendance file which is then sorted by student number. This file is matched against the master to update the students attendance history and produce a daily absence file. The absence file is sorted alphabetically and a daily absence report (figure 1) is prepared showing each student absent today and his total absences for the year. This report is forwarded to the school secretary who will prepare copies for distribution to all teachers. The attendance cards are returned to the homeroom teacher.

Three times each year the master file is sorted alphabetically to prepare a state-required report illustrating.

- a. student number
- b. student name
- c. grade
- d. sex
- e. summary by grade showing total enrollment and total absences

At the end of each marking period the file is sorted alphabetically to prepare the irregular attendance report (figure 3). This is an exception report of those students whose absences are greater than a predetermined school norm. The norm is four (4) but can be optionally changed, by inseting at program load time, a header card with a different school norm. This report contains:

- a. student number
- b. student name
- c. grade
- d. sex
- e. total absences this period and this year
- f. day of the week pattern of absences in total

Figure 4 is a systems flow chart of the attendance accounting procedures.

DATE		DAILY ABSENCE REPORT		PAGE NO.
STUDENT #	STUDENT NAME	GRADE	ABSENCES TO DATE	
1032	JOE A DOAKS	10	6	
1045	MARY I FORREST	9	2	
1129	HARRY B LAWLESS	12	1	
1361	PETER D SMITH	11	4	

FIGURE 1 - DAILY ABSENCE REPORT

# STATE-REQUIRED ATTENDANCE REPORT

ANY SCHOOL XX/XX/XX PAGE NO.

STUDENT NUMBER	STUDENT NAME	GRADE	M/F	MEMBERSHIP BELONGED	ILLNESS	OTHER ABSENT	TOTAL ABSENCES	DAYS IN ATTEND.
1402	WILLIAM A ALLEN	9	M	60	2	1	3	57
1003	MARY L ASKAM	9	F	60		1	1	59
1997	CHARLENE P DABBAGE	11	F	60				60
1307	JOHN L ECKERT	10	M	60	1	3	4	56
1502	ERNEST F NAUCHLY	12	M	60				60
1473	MALCOLM X O'CONNELL	9	F	60	3		3	57
SCHOOL TOTAL	MALE	MALE	GRADE	TOTAL				
	150	120	9	16200	25	19	44	16156
	135	142	10	16242	10	21	31	16211
	210	230	11	26400	73	30	103	26297
	175	225	12	24000	62	45	107	23893
	670	717		82842	170	115	285	82557
				1387				

FIGURE 2 - INDIVIDUAL ATTENDANCE

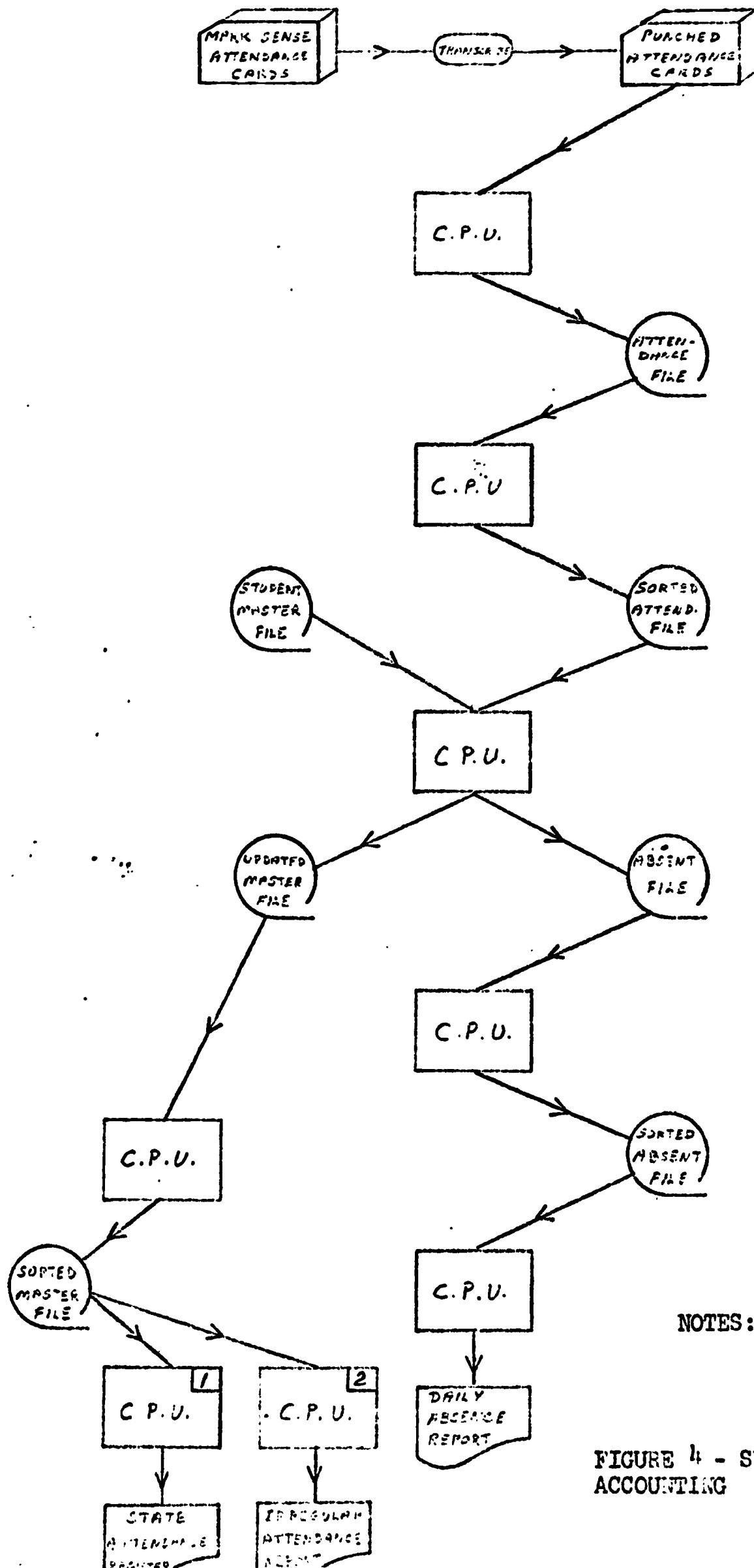
IRREGULAR ATTENDANCE

ANY SCHOOL		DATE XX/XX/XX								
STUDENT NUMBER	STUDENT NAME	GRADE	M/F	ABSENT MONTH	THIS YEAR	MON.	PATTERN TUES.	WED.	THURS.	FRI.
1496	JOHN S DOE	10	M	3	10	1	3		2	4
1063	ALEXANDRA P JONES	12	F	4	4		1	1	1	1
1975	JANE K SMITH	9	F	1	3	2				1
1209	SAMUEL N WOODS	11	M	5	12	1	3	2	1	5
1321	JOSEPH P ZILCH	12	M	4	13	6	1	1	1	4

FIGURE 3 = INCEPTION REPORT OF THOSE STUDENTS ABSENT MORE THAN THE PRE-DETERMINED

SCHOOL NORM





- NOTES: 1. AT STATE SPECIFIED INTERVALS  
2. END OF EACH MARKING PERIOD

FIGURE 4 - SYSTEMS FLOW OF ATTENDANCE ACCOUNTING

CASE STUDY B - MARK REPORTING

The purpose of this system is to gather student grades and produce report cards and other grade analysis reports. From the master course schedule mark sense cards produced containing the course number, course name, instructor number, instructor name and the student number. These cards are sent to each instructor at the end of every grading period for him to complete and return to the data processing department. The teacher mark senses each student's grade and any coded comments he may wish to make. After the mark sensing is transcribed, the cards are written on tape; this is the student grade file. This file is now sorted by student number and matched with the master student file to update the master reflecting current grades. This update is necessary to maintain the history of each students class performance and pertinent instructor comments. This data may be analyzed to keep the guidance counsellors up-to-date with each student's performance for guidance requirements. As the master is being updated a report card is also prepared for each student (Figure 1).

The student grade file is now sorted by course number and instructor number on order to prepare a mark analysis report (Figure 2) which lists each class showing:

1. Instructor number
2. Course number
3. Instructor name
4. Course title
5. Number of marks in each grade in the scale (A-B-C etc.)
6. The percentage of students receiving each grade.

Some other reports which may be produced from the student grades are:

1. Grade point averages
2. Ranked grade point average
3. Low grade report
4. Total grades by course

Figure 3 is a system flow chart of the mark reporting system.

FIGURE 1 = STUDENT REPORT CARD

STUDENT JOHN J SMITH		REPORT DATE 10-15-68	GRADE 9		DAYS ABSENT 4		MARK CODES A - OUTSTANDING B - GOOD C - SATISFACTORY D - MINIMUM F - FAILURE	
STUDENT # 10725		SCHOOL MEMORIAL HIGH						
COURSE NUMBER	COURSE TITLE	1ST INT. GR. COM.	2ND INT. GR. COM.	SEMESTER EXAM AVER.	3RD INT. GR. COM.	4TH INT. GR. COM.	SEMESTER EXAM AVER.	COURSE AVERAGE
201	ALGEBRA I	A						
407	AMER. LIT.	B						
651	U.S. HIST.	A						
352	FRENCH I	C						
706	PHYS. ED.	B						
208	GEN. SCI.	C						
COMMENT CODING								
1. PROGRESSING SATISFACTORILY				5. BOOKS AND MATERIALS NOT BROUGHT TO CLASS				
2. IMPROVING				6. BEHAVIOR NEEDS IMPROVEMENT				
3. BELOW APPARENT ABILITY				7. PLEASE CONTACT TEACHER THROUGH COUNSELLOR				
4. POOR ATTENDANCE AFFECTING WORK				PARENT OR GUARDIAN				

MEMORIAL HIGH			MARK ANALYSIS					AS OF 10/68				
TEACHER NO.	COURSE NO.	COURSE TITLE	# A's	# B's	# C's	# D's	# F's	% A's	% B's	% C's	% D's	% F's
102	325	ALGEBRA I	5	8	15	2	1	16	26	48	6	4
103	325	"	7	10	12	3		22	31	38	9	
104	325	"	4	8	18			13	27	60		
105	350	U.S. HIST.	10	12	8			33	40	27		
106	350	"	8	8	14	1		26	26	45	3	
106	375	PHYS. ED.	15	12	3			50	40	10		

FIGURE 2 = MARK ANALYSIS REPORT

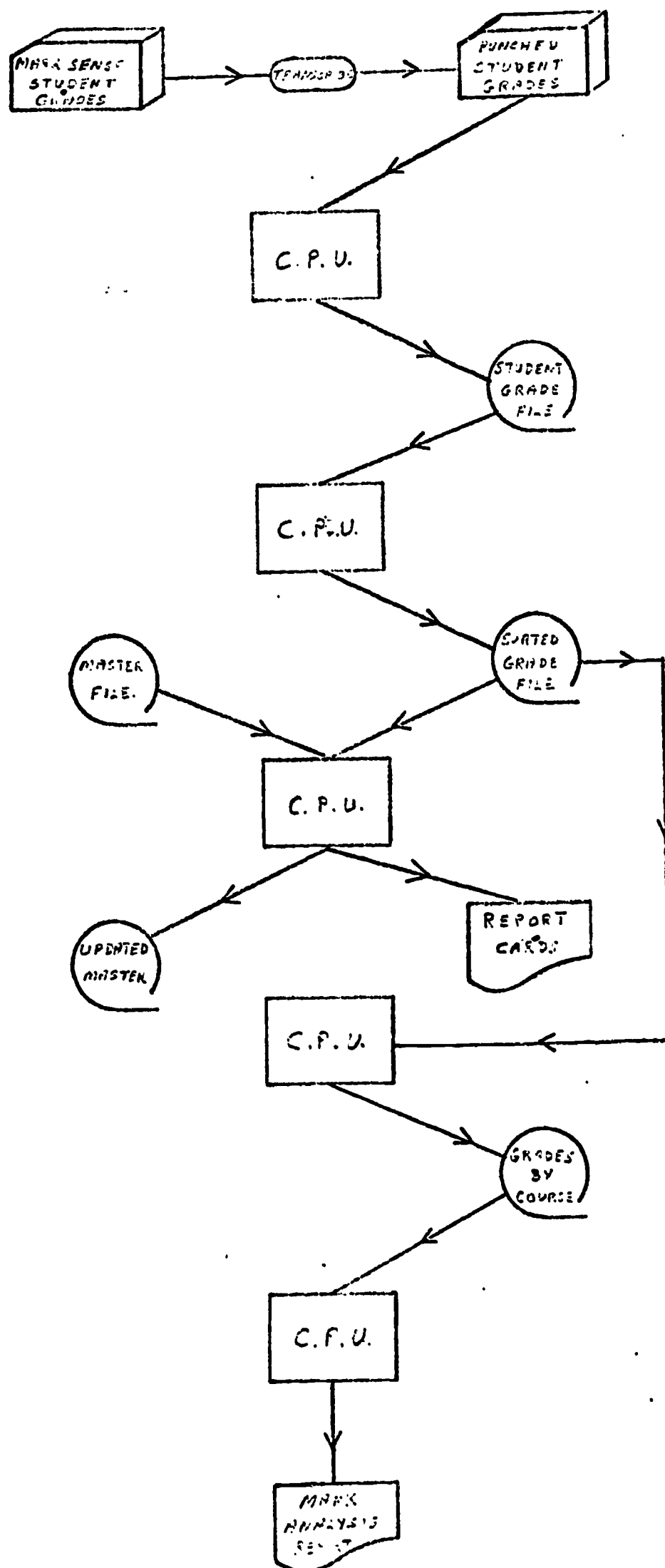


FIGURE 3 - SYSTEM FLOW OF STUDENT MARK REPORTING

CASE STUDY C - DISTRICT CENSUS

In order to aid school officials in effectively planning for the use of current facilities, building expansion, and faculty requirements, a master file of all children within the district is maintained. As a child is put on the master file he is assigned to the school in which he will be enrolled, according to pre-determined areas within the district. Each year a house to house canvass is made to verify existing data and record changes, such as new children, and those that have left the area. This data is transcribed to punched cards and used to update the master file along with cards indicating failure to be promoted, which are supplied by each school. During the update, a register is printed of each change made to the master file. For those children on the master not affected by a change card, the age and grade (if presently in school) are automatically advanced by one (1). The last page of this report is a recap of children by sex within age group. Figure 1 is a sample of this register.

The master file is then sorted alphabetically within each school. A report is then prepared by school showing:

1. Student name and address
2. Sex
3. Date of birth
4. Grade

As this report is prepared a file is created with information about pre-school children.

Figure 2 is an illustration of the alphabetical list of students by school. This report supplies the necessary information about present enrollment that administrators must have; it's also used by the school nurse and the attendance officer.

The file of pre-school children is now sorted by date of birth within the school in which they will be enrolled. A report is prepared which shows each child in age group within school. This report (Figure 3) supplies the administration with pertinent data on the demand that will be put on school facilities. This information will help to effectively plan for faculty and space requirements.

This system of census greatly reduces the clerical work needed to maintain census data, and to produce the statistics that must be available to best utilize present facilities and properly plan for future requirements.

Figure 4 illustrates one method of processing census data.



CENSUS CHANGE REGISTER

1968

NAME	ADDRESS	SEX	SCHOOL	GRADE	CHANGE
MARY A BROWN	35 JONES STREET	F	10		NEWBORN
ALICE B COIN	441 MAIN ROAD	F	8	12	DECEASED
TOM C FIELD	39 VINE STREET	M	10	9	TRANS FROM SCHOOL 6
PETER D HALL	107 RACE STREET	M	7	10	MOVED AWAY
PAUL E JONES	39 ASH STREET	M	5	9	FAILED GRADE 9

AGES	UNDER	01	02	06	07	13	14	15	16	TOTAL
BOYS	45	59	39	72	81	75	82	63	91	1,789
GIRLS	52	58	46	79	95	68	85	92	85	2,125

FIGURE 1 = CHANGE TO THE MASTER CENSUS FILE AND RECAP BY AGE GROUP

SCHOOL NO: 10 SCHOOL NAME: MEMORIAL HIGH

STUDENT	ADDRESS	SEX	BIRTH	GRADE	SCHOOL
JOHN A ADAMS	123 HIS STREET	M	6 - 12 - 42	10	10
MARY N BROWN	72 MAIN STREET	F	7 - 13 - 42	10	10
MARTHA L CLASS	35 VINE STREET	F	8 - 15 - 40	12	10
PETER J COOPER	107 RACE STREET	M	9 - 21 - 43	9	10
TOM T FREEMAN	212 CROWN LANE	M	3 - 17 - 41	11	10
ANN L LONG	21 PARK AVE	F	12 - 25 - 43	9	10

FIGURE 2 = ALPHABETICAL LIST OF STUDENTS BY SCHOOL

SCHOOL NO: 10 SCHOOL NAME: MEMORIAL HIGH

NAME	ADDRESS	SEX	BIRTH
JOHN A DOE	121 SOUTH STREET	M	6 - 12 - 62
BILL M FIELD	72 OAK STREET	M	5 - 25 - 62
ALICE L HOPE	102 ASH STREET	F	2 - 23 - 62
PETER B SMITH	77 VINE STREET	M	12 - 18 - 63
MOLLY F BROWN	395 MAIN STREET	F	3 - 15 - 63
MARY G JONES	33 RACE STREET	F	11 - 21 - 64
TOM H HOPE	102 ASH STREET	M	7 - 21 - 65

FIGURE 3 = PRE-SCHOOL CHILDREN BY BIRTHDAY WITHIN SCHOOL ASSIGNED

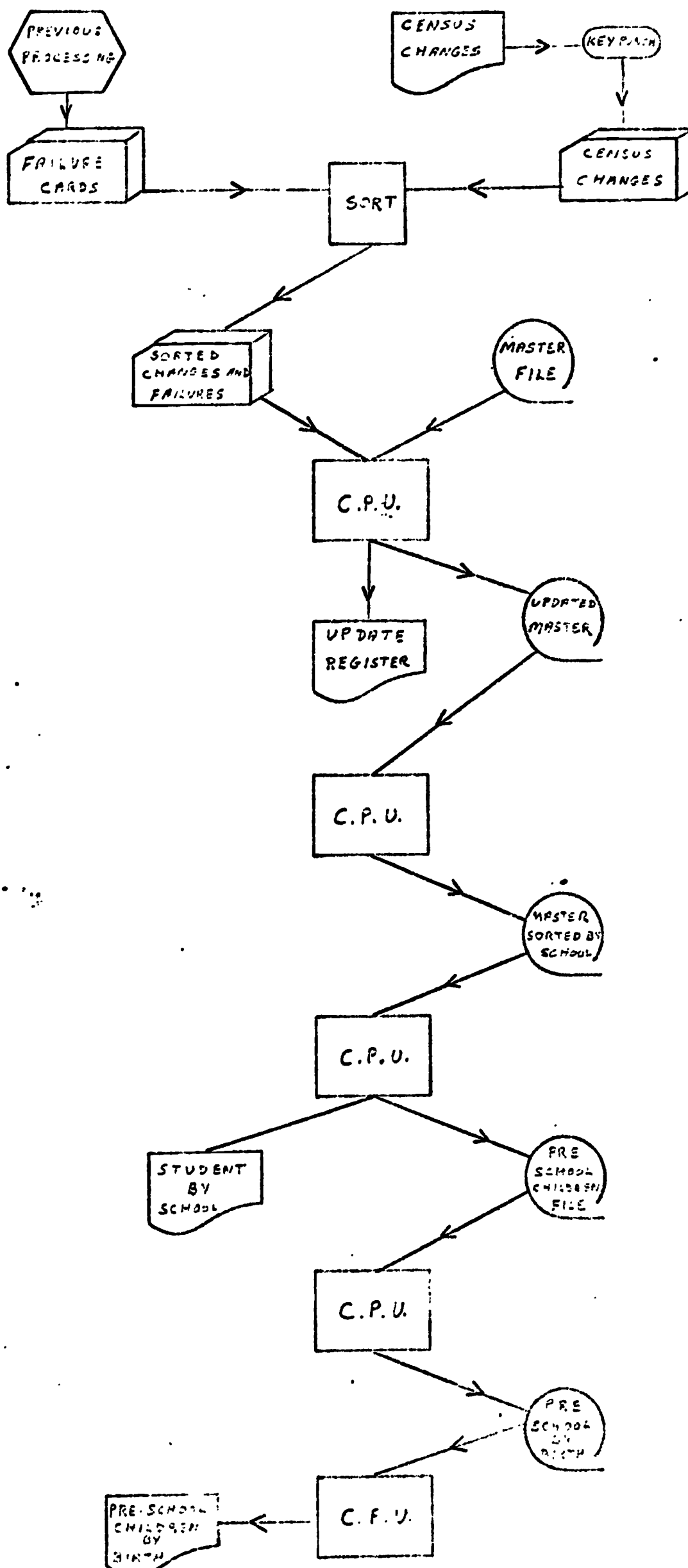


FIGURE 4 - SYSTEM FLOW OF SCHOOL DISTRICT CENSUS PROCESSING.

## II. OTHER APPLICATIONS

- A. School Budgeting and Accounting
- B. Payroll
- C. Purchasing
- D. Inventory of School Supplies
- E. Payable & Receivables
- F. Cafeteria Accounting
- G. Library Cataloging
- H. Registration and Class Scheduling

ADVANCED CLASS PROBLEM

Suggested Time: Eighteen hours

Content: A case problem requiring the extension of an application to incorporate additional functions.

Major Division:

I. PRESENTATION OF PROBLEM REQUIREMENTS

Objective:

To enable the student to apply his data processing knowledge in a realistic situation. This is achieved by presentation of requirements which must be added to an existing application. At this point the student should have the ability to develop a feasible system and to specify the details: file design, program requirements, and report layouts.

ADVANCED CLASS PROBLEM

I. PRESENTATION OF PROBLEM REQUIREMENTS

**Problem Statement:**

The grade reporting system, as presented in Applications in School Administration, produces two reports; Report Cards and Mark Analysis. The system is to be expanded to produce Honor Roll Lists, Failure Lists, Grade Point Averages, and Cumulative Rank in Class, for a district reporting 7000 students in grades 9 - 12. Each report is prepared at the end of the marking period.

**Report Specifications:**

1. Grade Point Averages: Courses are identified by a three-digit number (which appears on the Report Card), and a course weight. The weight is determined by the Principal and Superintendent and is used in the grade point computations and also in determination of graduation credit points. Course weights are normally one, but may range from .3 to 2, which is based on the number of course hours and other factors. A course weight less than 1 indicates the course is not a major subject. Grades are reported alphabetically: A, B, C, D, and F. The computation uses the numeric equivalents: A = 4, B = 3, C = 2, D = 1, F =  $\emptyset$ .

The computation to determine Grade Point Averages is based on major subjects only:

Course Weight X Grade = Quality Points.

Total Quality Points  $\div$  Number of Subjects = Grade Point Average.

The report sequence is the same as the student master file: student number within homeroom within grade.

2. Honor Roll Lists: Two honor roll lists are to be prepared.

Students with a grade point average of 3.833 and higher are listed on the "A" Honor Roll, students within the range 3.0 to 3.832 are listed on the "B" Honor Roll. The sequence of the Honor Roll lists is alphabetic by student name within grade.

3. Failure Lists: A Failure List is to be prepared which shows every student who has received an "F" Grade in any course. The report sequence is by student number within homeroom.

4. Rank In Class: The students' rank in class is based on the performance in grades 10, 11, and 12. The basis for class rank is the grade point average for these three years and is cumulative. When determining class rank there may be a number of students with the same grade point average. To arbitrarily assign them to sequential position would not be fair to the individual, therefore a standard formula has been developed by Middle Atlantic States Accreditation Commission, to rank students having the same average in equal positions. The formula consists of adding the relative positions and dividing by the number of students to determine the result. For example, relative positions 2 thru 6 consists of students having the same average. The accumulation of rank positions,  $(2+3+4+5+6=20)$  divided by the number of students (5) would result in the 5 students being ranked as 4. The next student rank would be 7.



<u>Relative Pos.</u>	<u>Rank</u>	<u>G.P.A.</u>
1	1	4.00
2	4	3.75
3	4	3.75
4	4	3.75
5	4	3.75
6	4	3.75
7	7	3.50

This report sequence is by rank.

Several useful techniques may be employed by the instructor to stimulate class discussion: The class may be divided into teams of 3 or 4 students, with each team presenting a solution. The computer hardware configuration may be left to the discretion of each team, or the instructor might assign various configurations. The instructor may assign the entire problem or any of its portions.

The problem presents an opportunity for the class to become aware of the variety of successful solutions that are possible in any application.

An example of a typical Student Master Record is incorporated as supplemental material to aid the instructor in keeping this area of discussion to a minimum.

EXAMPLE: STUDENT MASTER RECORD

1. School Identification
  - a. County
  - b. District
  - c. School
2. Student Number
3. Attendance Category
4. Beginning Attendance Month
5. Student Name
6. Street
7. City
8. State
9. Zip Code
10. Sex
11. Telephone
  - a. Area Code
  - b. Prefix
  - c. Suffix
12. Birthday
  - a. Month
  - b. Day
  - c. Year
13. Birthplace
14. District of Residence
  - a. County
  - b. District
15. Entry Date
  - a. Month
  - b. Day
  - c. Year
16. Leave Date
  - a. Month
  - b. Day
  - c. Year
17. Parent or Guardian Name
18. Emergency Contact
19. Emergency Phone
  - a. Area Code
  - b. Prefix
  - c. Suffix
20. Counselor Name
21. Monthly Attendance Picture
  - a. Four weeks
  - b. Five days each week
22. Yearly Attendance Picture
  - a. Count by day of week

23. Total Yearly Absence
  - a. Sick
  - b. Unexcused
  - c. Not enrolled
24. Apportionment Days (total no. of days attended)
25. Courses (approximately eight)
26. Achievement Test Data
  - a. Test ID
  - b. Form
  - c. Level
  - d. Date
  - e. Grade
  - f. Norm
27. Scores for the Sections of the Achievement Test
  - a. Sub-test number
  - b. Sub-test score
28. Aptitude Test Data
  - a. Test ID
  - b. Form
  - c. Level
  - d. Date
  - e. Grade
  - f. Norm
29. Aptitude Scores
  - a. Language
  - b. Non-language
  - c. Total
30. Grade Point Average

### INFORMATION RETRIEVAL

**Suggested Time:** Six hours

**Content:** A discussion of the concepts and techniques utilized in storing and retrieving data.

**Major Divisions:**

- I. NEED
- II. FUNCTIONS OF FILE MANAGEMENT
- III. PROCESSING CONSIDERATIONS
- IV. IMPLEMENTATION CONSIDERATIONS
- V. DATA BASE SYSTEMS
- VI. REFERENCE SYSTEMS

**Objective:**

To familiarize the student with the concepts and techniques of Information Retrieval. The application of computer technology to the handling of large volumes of data has been termed Information Storage and Retrieval (IS & R), or more simply, Information Retrieval (IR).

This application is unique in that it is applicable to any discipline and has been utilized in government, industry, science, and education. The instructor should discuss the theories involved in computer processing and current applications. It should be

noted that the most current reference material in this area will generally be found in the publications of computer manufacturers and technical journals, as new applications are constantly being developed.

## INFORMATION RETRIEVAL

### I. NEED

- A. Large volumes of data
  - 1. Developments in specialized areas
  - 2. Application of data in other areas
- B. Growth of inter-disciplinary fields
  - 1. Biochemistry
  - 2. Mathematical psychology
- C. Industry and government
  - 1. Flood of paper work
  - 2. Specialization
  - 3. Multiple usage of information

### II. FUNCTIONS OF FILE MANAGEMENT

- A. Adding records
- B. Deleting records
- C. Changing records
- D. Searching files
- E. Production of document or index

### III. PROCESSING CONSIDERATIONS

- A. Reponse time
- B. Method
  - 1. Batch processing
  - 2. Real-time processing
- C. Hardware requirements

#### IV. IMPLEMENTATION CONSIDERATIONS

##### A. Utility

1. Large cost of developing data base
2. Difficulty in defining future uses
3. Determination of data to be acquired
4. Reliability of data

##### B. Communications

1. Translation of requests
2. Future uses

##### C. Pattern matching

1. Selection of relevant data
2. Key word concept
3. On-line techniques

##### D. File organization

1. File size considerations
2. Structured files
3. Response time

##### E. Data security provisions

##### F. Program considerations

1. Original programs
2. Generalized file management package programs
  - a. Sources
    - (1) Manufacturers
    - (2) Software houses

b. User implementation requirements

- (1) Establish organization and content of data files
- (2) Prepare data description statements
- (3) Enter procedural statements
- (4) Define procedures

V. DATA BASE SYSTEMS

A. Data base content

B. Record organization

1. Fields
2. Records
3. File
4. Sequence

C. Examples

1. Management Information Systems (MIS)
2. Medical diagnostic records systems
3. Census
4. Statutes
5. Criminal information

VI. REFERENCE SYSTEMS

A. Data content

1. Index
2. Criteria selection

B. Document retrieval

1. Printed page



2. Microfilm

3. Microfiche

C. Examples

1. Library cataloging

2. Dissertations index

3. Research and development index

PHASE THREE

ADVANCED APPLICATIONS TO  
INDIVIDUAL DISCIPLINES

CLASS

LABORATORY

TOTAL

Concepts of Computer Assisted Instruction	5	1	6
Selection of a Computer	6	6	12
Data Processing Teaching Aids	2	1	3
Current Applications in Education	6	3	9
Individual Problem	6	24	<u>30</u> 60

CONCEPTS OF COMPUTER ASSISTED INSTRUCTION

Suggested Time: Six hours

Description: A discussion of the use of computers in the application and administration of educational courses.

Major Divisions:

- I. BACKGROUND
- II. INSTRUCTIONAL APPLICATIONS
- III. ADMINISTRATIVE APPLICATIONS
- IV. HARDWARE COMPONENTS
- V. SOFTWARE COMPONENTS
- VI. CURRICULUM SOURCES
- VII. ADVANTAGES

Objective:

To acquaint the teacher with the potential of the computer as an educational tool in curriculum development and presentation.

Computer-Assisted-Instruction (CAI) can be considered as an application of Information Retrieval on a real-time basis. However, the potential of CAI allows educators to apply their own experience in the development of CAI programs. The various types of programs available and the considerations in using CAI as an effective classroom tool should be discussed.

If a CAI system does not exist within the immediate area a demonstration may be arranged in the classroom by a manufacturer.

CONCEPTS OF COMPUTER ASSISTED INSTRUCTION

I. BACKGROUND

- A. Explanation of CAI
- B. Comparison to teaching machines
- C. Student relationship to CAI
- D. Teacher relationship to CAI

II. INSTRUCTIONAL APPLICATIONS

- A. Drill and practice
- B. Tutorial - Comparison to programmed instruction textbooks
- C. Dialogue
- D. Examples
  - 1. Primary reading and arithmetic
  - 2. Development of math concepts
  - 3. High school geometry

III. CAI - ADMINISTRATIVE APPLICATIONS

- A. Student progress reporting
- B. Class progress reporting
- C. Student grading
- D. Maintenance of student history

IV. HARDWARE COMPONENTS

- A. Central processor
- B. Large-capacity storage units
  - 1. Random access devices

- C. Transmission control units
- D. Student/author stations
  - 1. Visual projection devices
  - 2. Typewriter units
  - 3. Audio response units

## V. SOFTWARE

- A. Special-purpose programming language
  - 1. Designed for use by professional educators
  - 2. Personalized course development
- B. Data management routines
- C. Text editors
- D. Operating systems
- E. Utility reports
  - 1. File update
  - 2. Class progress
  - 3. Student progress
  - 4. Demonstration routines

## VI. CURRICULUM SOURCES

- A. Textbook publishers
- B. Computer manufacturers
- C. Original course material

## VII. ADVANTAGES

- A. Student

1. Proceeds at own rate
2. Individualized instruction
3. Incentive to learning.

**B. Teacher**

1. Relieved of drill & review
2. Time for more individualized instruction
3. Accurate daily progress reports of individual students and entire class.

**C. School**

1. Efficient utilization of skilled educators
2. Administrative processing and record-keeping
3. Information useful for research in educational methods and theory.

## SELECTION OF A COMPUTER

**Suggested Time:** Twelve hours

**Description:** An outline of the elements important to the selection of a Data Processing system

**Major Divisions:**

- I. CLASSIFICATION OF COMPUTER
- II. CENTRAL PROCESSOR
- III. PERIPHERAL DEVICES
- IV. SOFTWARE
- V. FUTURE GROWTH
- VI. SERVICE SUPPORT
- VII. SYSTEMS SUPPORT
- VIII. EDUCATION SUPPORT
- IX. CONTRACTS
- X. PHYSICAL REQUIREMENTS

**Objectives:**

To acquaint the participant with the elements which must be considered in the evaluation of a computer. This section is designed to be used as a guide in evaluating proposals for a data processing system. The relative importance of each element would be dependent upon specific requirements; i.e., systems support would be a major consideration with inexperienced personnel. However, an organization might



choose to hire experienced professionals and therefore this element, while still important, would not be a priority consideration.

While many of these topics have been discussed earlier in the course, the objective at this time is to inform the student of the many factors that must be evaluated and that cost is only one of several considerations.

## SELECTION OF A COMPUTER

### **I. CLASSIFICATION OF COMPUTERS**

#### **A. Analog**

#### **B. Digital**

- 1. General Purpose**
- 2. Special Purpose**
- 3. Business**
- 4. Scientific**

### **II. CENTRAL PROCESSOR**

#### **A. Speed**

- 1. Basic cycle time**
- 2. Instruction execution time**

#### **B. Command repertoire**

- 1. Standard**
- 2. Optional**

### **III. PERIPHERAL DEVICES**

#### **A. Speed**

#### **B. Cost of Storage**

- 1. Cost of Device**
- 2. Cost of Storage Medium**

#### **C. Availability of Standard Devices**

- 1. Magnetic tape**
- 2. Disk**

3. Drum
4. Card reader
5. Card punch
6. Paper tape reader
7. Paper tape punch
8. Printer

**D. Availability of Required Special Devices**

1. Visual projectors
2. Audio reponse units
3. MICR readers
4. Others

**E. I/O Buffering Devices**

1. Transfer rate
2. Degree of simultaneity with CPU

**IV. SOFTWARE**

**A. Programming Languages**

1. COBOL
  - a. Number of required elements
  - b. Number of optional elements
  - c. Degree of conformance to standards
2. Fortran
3. Other languages
  - (1) Assembler
  - (2) Special-purpose languages

**B. Programming Aids**

1. Input-output control systems
2. Arithmetic subroutines
  - a. Multiply/divide
  - b. Square root
  - c. Others

**C. Operating Systems**

1. Overhead
2. Efficiency
  - a. Utilization of hardware capabilities
  - b. Maintenance effort
  - c. Comparison to competition

**D. Program Maintenance and Debugging Aids**

1. Cross reference routines
2. Symbolic program maintenance
3. Relocation monitors
4. Flowchart routines

**E. File Maintenance**

1. File creation routines
2. File reorganization routines

**F. Data Manipulation Routines**

1. Sorts
2. Collates
3. Merges
4. Edits

**G. Overhead**

1. Storage
2. I/O devices

**H. Applications Software**

1. Availability
  - a. Types of packages
  - b. Conformance to customer needs
2. Efficiency
  - a. Core overhead
  - b. Utilization of hardware features
3. Ease of Maintenance
4. Documentation
  - a. Flow Charts
  - b. Coding comments
  - c. Operation instructions
  - d. Maintenance instructions
5. Other Users
  - a. Opinion of efficiency
  - b. Amount of usage

**I. Software Distribution**

1. Method
2. Updating provisions

## V. FUTURE GROWTH

### A. Additional Hardware Capabilities

1. Memory
2. I/O devices

### B. Program Compatibility

1. Degree of reprogramming effort
2. Conversion aids

## VI. SERVICE SUPPORT

### A. Competency

1. Formal education
2. Prior experience

### B. Response Time

### C. Local Parts Supply

### D. Knowledge of Particular Hardware

1. Previous experience
2. Special education

## VII. SYSTEMS SUPPORT

### A. Competency

1. Formal education
2. Special training
3. Previous experience on hardware
4. Previous experience in related applications

### B. Commitment

1. Number of people
2. Length of time
3. Verbal or written
4. Names and qualifications specified in contract

C. Reference Manuals

1. Completeness
2. Ease of use
3. Updating

VIII. EDUCATION SUPPORT

A. P.I. Courses

1. Number available
2. Subjects

B. Seminars

1. Management
2. Systems
3. Applications

C. Formal Schools

1. Qualifications of staff
2. Types
  - a. Management
  - b. Systems analyst
  - c. Programmers
  - d. Operations personnel

3. Location

- a. Local
- b. Regional
- c. Home office

IX. CONTRACTS

A. Lease Contracts

- 1. Educational discount
- 2. Length of lease
- 3. Monthly rental
  - a. Short term
  - b. 2 year
  - c. 3 year
  - d. 5 year
- 4. Overtime charges
- 5. Upgrading charges
- 6. Downgrading charges

B. Purchase Contracts

- 1. Systems Support
- 2. Interest
- 3. Rental applied to purchase price
- 4. Maintenance cost
- 5. Upgrading costs
- 6. Educational discounts

C. Leasing Companies



## **X. PHYSICAL REQUIREMENTS**

- A. Room size**
- B. Air conditioning**
- C. Access requirements**
- D. Weight and stress requirements**
- E. Lighting**
- F. Humidity**
- G. Types of floor coverings allowed**
- H. Cabeling**
  - 1. False floor**
  - 2. Cable runways**
- I. Electrical requirements**
  - 1. Number of circuits**
  - 2. Volts-amps**
  - 3. Electrical fitting**
    - a. Types**
    - b. Sizes**

CLASS PROBLEM SUPPLEMENT

**Objectives:**

This problem was designed to guide the student through a typical situation in the evaluation of computer systems.

The student will be presented with summary proposals from three (3) pseudo Computer Vendors. He will be required to evaluate these proposals according to the guidelines taught in the evaluation section, and to indicate and justify his selection.

A further objective is to create class discussion on the completeness of the proposals. This is a representation of actual situations, and will demonstrate to the student the procedures necessary for competent selection.

It should be noted that any question that might not be answered by the proposal, should be treated as being negative. This will be in keeping with the guidelines, in that all commitments and promises must be in writing.

The following is a summary of proposals, prepared by a consultant, from three (3) computer manufacturers. Evaluate these proposals according to the guidelines presented in the equipment evaluation section. There are two desired results:

1. Choice of vendor
2. Justification of choice

The jobs for which the computer is initially being purchased are listed below:

1. Payroll
2. Pupil Census
3. Student Scheduling
4. Mark Reporting
5. Failure Analysis and Reporting
6. Budget and General Accounting
7. Dropout Analysis and Reporting

The School District has estimated the above jobs will take twelve (12) months to implement. Upon completion they will begin to implement computer assisted instruction from remote locations, using sixty (60) visual display terminals.

The following is a summary of each vendors proposal:

VENDOR I

I. HARDWARE

A. CPU

1. 8,000 characters of core memory
2. 4.0 micro-second memory cycle
3. Decimal arithmetic
4. No multiply/divide hardware (software available)
5. Financial edit feature
6. No read/write/compute simultaneity

B. 800 CPM Card Reader

C. 400 CPM Card Punch

D. 350 LPM printer with 120 print positions

E. Sorter, Collator, Interpreter, Reproducer

This vendor proposes to sell a card system initially and to upgrade this in one year to a more sophisticated system with tape, disk, and communications capabilities, which would not have program compatability.

The vendor feels the advantage of this system is low initial rental.

II. LANGUAGES

Basic Coding Language

III. DATA MANIPULATION ROUTINES

A. Limited peripheral conversion routines

B. Macro routines.

**IV. OPERATING SYSTEM**

None available on cards

**V. PROGRAM MAINTENANCE AND DEBUGGING AIDS**

A. Memory dump routines

B. Cross reference routines

**VI. APPLICATIONS SOFTWARE**

None available

**VII. SYSTEMS SUPPORT**

Experienced personnel in an advisory capacity.

**VIII. SERVICE SUPPORT**

Trained personnel with service rendered on an "on-call basis."

**IX. EDUCATION SUPPORT**

There are several formal classes and seminars available for management and programming personnel. There are no formal classes for operations personnel.

There are several excellent Programmed Instruction courses available for programming and operations personnel.

All formal education is done in the regional education center, one hundred miles away.

The quality of the teaching personnel is generally high.

X. SOFTWARE DISTRIBUTION

Direct from home office, by request.

XI. REFERENCE MANUALS

Extremely technical but complete, distributed directly to user.

XII. COSTS PER MONTH FOR 200 MACHINE HOURS - \$2,875.00

- A. System is upgraded with additional monthly rental.
  - B. System cannot be down-graded during length of contract.
  - C. Overtime will be all usage in excess of 200 machine hours.
- Overtime Charge . . . \$10.50 per hour

## VENDOR II

### I. HARDWARE

#### A. CPU

1. 32,000 characters of memory
2. 800 nanosecond memory cycle
3. Decimal arithmetic
4. Binary arithmetic
5. Multiply/divide hardware
6. No financial edit (software available)
7. Complete read/write/compute simultaneity
8. Communications interface

#### B. 1100 CPM Card Reader

#### C. 250 CPM Card Punch

#### D. 1100 LPM Printer with 132 Print Positions

#### E. 3-12 million character disk drives - 180 KB (1 drive for operating system)

#### F. 4 input/output channels

#### G. 4-800 BPI tape drives-67KB

This vendor proposes a system that will handle the current jobs more efficiently as the additional jobs are implemented. He feels the additional cost for the first twelve months is offset by having the largest volume of information on tape rather than cards. The disk drives are justified by the use of a more advanced operating system and allow the programmers to gain disk experience. The

required communications abilities are a standard feature of this computer.

## II. LANGUAGES

- A. Basic coding language
- B. COBOL 65'
- C. Fortran IV
- D. Algol

## III. DATA MANIPULATION ROUTINES

- A. I/O control systems
- B. Sorts/collates/merges
- C. Macro assemblers
- D. Some peripheral conversion routines
- E. File maintenance routines

## IV. OPERATING SYSTEMS

- A. Tape resident - adequate, requires 5,000 characters of memory.
- B. Disk resident - rated excellent by users however requires 8,000 characters of overhead.

## V. PROGRAM MAINTENANCE AND DEBUGGING AIDS

- A. Symbolic program maintenance
- B. Object program maintenance
- C. Trace routines
- D. Memory and peripheral print routines



VI. APPLICATIONS SOFTWARE

- A.. Very good library of payroll and general accounting packages including accounts receivable and payable.
- B. Excellent student scheduling packages.
- C. Written in COBOL primarily with some of the inventory programs in Fortran.

VII. SYSTEMS SUPPORT

Experienced personnel, with one man committed a full year, for programming and systems support.

VIII. SERVICE SUPPORT

Trained personnel available on call.

IX. EDUCATION SUPPORT

Numerous formal classes for management programmers and operators. There are several programmed instruction courses for all Data Processing personnel.

Formal education available:

- A. Home Office
- B. Regional Education Centers
- C. Branch Offices
- D. Customers Offices

X. SOFTWARE DISTRIBUTION - distributed upon request by user.

XI. REFERENCE MANUALS

Well written and easy to understand.

XII. COSTS PER MONTH FOR UNLIMITED USE - \$4,300.00

- A. System can be upgraded with additional monthly rental.
- B. System can be downgraded, by paying a pro-rated share of the total contract rental.

### VENDOR III

#### I. HARDWARE

##### A. CPU

1. 32,000 character of memory
2. 1.0 micro-second memory cycle
3. Decimal Arithmetic
4. Binary Arithmetic
5. Multiply-divide hardware
6. Financial edit
7. Complete read/write/compute simultaneity

##### B. 800 CPM Card Reader

##### C. 200 CPM Card Punch

##### D. 600 LPM printer with 132 print positions

##### E. Two Input/Output channels

##### F. Five - 800 BPI tape drives - 89KB

This vendor proposes that he can satisfy the work load requirement with five tape drives. He states he does not feel there is a need for random access devices now and proposes that the disk drives not be added for one year. This, he states, will permit a lower hardware rental for the first year, without affecting efficiency. To allow communications a special feature must be installed at an additional monthly charge of one hundred dollars (\$100).

## II. LANGUAGES

- A. Basic Coding Language
- B. COBOL 65'
- C. Fortran IV

## III. DATA MANIPULATION ROUTINES

- A. I/O control systems
- B. Sorts/merges/collates
- C. Macro assemblers
- D. Library of peripheral manipulation routines
- E. File maintainance routines

## IV. OPERATING SYSTEMS

- A. Tape Resident - good, requires 5,000 character of memory.
- B. Disk Resident - fair, requires 10,000 characters of memory.

## V. PROGRAM MAINTENANCE AND DEBUGGING AIDS

- A. Symbolic program maintenance
- B. Object program maintenance
- C. Trace routines
- D. Cross reference routines
- E. Memory dump
- F. Peripheral print
- G. Flow chart program

VI. APPLICATIONS SOFTWARE

- A. An excellent library of payroll and general accounting packages including accounts receivable and payable.
- B. Written primarily in Assembler Language

VII. SYSTEMS SUPPORT

One full time experienced systems engineers for one year.

VIII. SERVICE SUPPORT

Full time trained engineer "on site," with one hour response for additional specialized support.

IX. EDUCATION SUPPORT

Numerous formal classes for programmers and operators, at the regional education centers. There are several Programmed Instruction courses available for all Data Processing personnel.

X. SOFTWARE DISTRIBUTION

- A. System engineers responsibility, distributed by home office.

XI. REFERENCE MANUALS

Technically written, difficult to understand.

XII. COSTS PER MONTH FOR 200 MACHINE HOURS - \$3,200.00

- A. Systems is upgraded with additional monthly rental.
- B. System can be downgraded by paying a "one time" service charge and a pro-rated share of the total contract rental.

C. Overtime will be all usage in excess of 200 machine hours.

Overtime Charge . . . \$20.00 per hour

D. Two disk drives will be added to the system at the end of  
the first year at an additional monthly rental of \$500 per drive.

SUGGESTED SOLUTION TO COMPUTER SELECTION PROBLEM

VENDOR #1

This proposal might be suitable if financial resources were limited and future expansion were not planned.

However, this proposal is not satisfactory for the following reasons:

1. Lack of systems support, which is a requirement due to inexperienced personnel.
2. No problem-oriented languages, which results in greater training effort and more programming effort, as assembly language programs are more difficult to develop.
3. Lack of software and applications packages, which again adds to the programming effort.
4. Probability of overtime rental due to the volume of data being processed on cards.
5. Cost of complete reprogramming on a new computer system for implementation of the computer-assisted instruction phase.

VENDOR #2

This proposal might be satisfactory if the initial requirements could justify both tape and disk. However, the disk files would not be utilized until the computer-assisted instruction phase were implemented and therefore, \$13,200.00 would be needlessly invested on one year's rental.

VENDOR #3

This proposal is the most satisfactory to fulfill the requirements. The vendor specifies the hardware and software to economically implement both the initial phase and the computer-assisted instruction phase.

The manufacturers support committed in writing is more than adequate: one full-time systems person, readily available service engineers, and sufficient education support.

The ability to add disk drives when they are needed, without reprogramming effort, proves more economic than the methods suggested by the other proposals.



DECISION TABLE ON COMPUTER SELECTION

<u>ELEMENT</u>	<u>VENDOR #1</u>	<u>VENDOR #2</u>	<u>VENDOR #3</u>
I. HARDWARE	G	E	E
II. LANGUAGES	P	E	E
III. DATA MANIPULATION ROUTINES	F	G	E
IV. OPERATING SYSTEMS	N/A	G	F
V. PROGRAM-MAINTENANCE AND DEBUGGING AIDS	F	G	E
VI. APPLICATIONS SOFTWARE	N/A	G	F
VII. SYSTEMS SUPPORT	F	E	G
VIII. SERVICE SUPPORT	G	G	E
IX. EDUCATION SUPPORT	G	E	G
X. SOFTWARE DISTRIBUTION	G	F	G
XI. REFERENCE MANUALS	G	E	F
XII. COST	G	G	G

KEY E - EXCELLENT  
G - GOOD

F - FAIR  
P - POOR

N/A - NOT APPLICABLE

DATA PROCESSING TEACHING AIDS

**Suggested Time:** Three hours

**Description:** Presentation of techniques available to aid in the teaching of the complexities of data processing.

**Major Divisions:**

I. TEACHING AIDS

II. SOURCES OF INFORMATION

**Objective:**

To introduce the participants to advances and improvements that have been made in learning materials for data processing. The integration of these aids into the teaching-learning process of today's expanded and complex curricula, particularly in the area of computer technology, can result in an acceleration and enrichment of the learning process. By sample presentations and detailed class discussions, the educators will formulate the special specific contribution that each of these teaching tools can make in the classroom. Many of the classroom tools mentioned are supplied by the data processing manufacturers at little or no cost to the user.

A review of the Appendices can aid in illustrating sources of information.

DATA PROCESSING TEACHING AIDS

**I. TEACHING AIDS**

**A. Data processing terminology booklets**

**B. Audio/Visual aids**

1. Slides
2. Film strips
3. Movies
4. Overhead projection foils
5. Models
6. Tape recorded learning courses
7. Television

**C. Programmed instruction courses**

**D. Interest stimulating computer programs**

1. Management games (Business simulation)
2. Novelty programs
  - a. Music producing
  - b. Personality portraits
  - c. Tic-tac-toe
  - d. Baseball games

**E. Laboratory supplies**

1. Coding forms
2. Flow chart templates
3. Flow chart worksheets
4. Reference summary cards

F.. Field trips

## II. SOURCES OF INFORMATION

- A. Data processing equipment manufacturers
- B. Data processing journals and societies
- C. Education journals and societies
- D. Management journals and societies
- E. Government agencies
- F. Industrial educational services
- G. Educational Research Reports
- H. Dissertations

CURRENT APPLICATIONS IN EDUCATION

**Suggested Time:** Nine hours

**Description:** A review of the various applications of computer technology in education.

**Major Divisions:**

- I. CURRICULUM MATERIALS
- II. SIMULATION
- III. GUIDANCE
- IV. HUMANITIES
- V. SOCIAL SCIENCES
- VI. LANGUAGE AND LITERATURE
- VII. PHYSICAL AND LIFE SCIENCES

**Objective:**

To make the student aware of the uses of computer technology as an educational tool. A sampling of existing applications is given as an indication of areas where computers have been utilized and should provide an awareness of future trends. Many articles and special editions of educational journals covering this area are listed in the Bibliography and could be issued as text.

CURRENT APPLICATIONS IN EDUCATION

I. CURRICULUM MATERIAL

- A. Ordering
- B. Cataloging
- C. Requisitioning
- D. Analysis of Use
  - 1. Teacher
  - 2. Department
  - 3. Subject
  - 4. Teacher
- E. Cost Analysis

II. SIMULATION

- A. Curriculum Simulation
  - 1. Reduce time lag between new instructional systems and their implementation
  - 2. Test alternatives
- B. Computer - Simulated Instruction (Gaming)
  - 1. Applies to all grade levels
  - 2. Student participation more active than in lecture technique.
  - 3. Examples
    - a. Transportation and logistics management
    - b. Managerial decision making in marketing, production and finance.

### III. GUIDANCE

#### A. Statistical Reports

1. Abilities vs. achievement
2. Dropout prediction and analysis
3. Grade History

#### B. Uses

1. Matching prior student performance with schedule requests
2. Matching past performance and interest with vocational and career choices
3. Relieve counselor of role of disseminating information
4. Allow counselor more time for better personnel relationship with student

### IV. HUMANITIES

#### A. Central file for art listing

1. Artists
2. Titles
3. Descriptions
4. Bibliographic references

#### B. Music

1. Style analysis
2. Theme indexing

### V. SOCIAL SCIENCES

#### A. Population census analysis

- B. Demographic data analysis
- C. Processing of Congressional roll calls
- D. Processing of Congressional voting records
- E. Election analysis and prediction
- F. Analysis of International relations
- G. Classification of archeological artifacts

#### VI. LANGUAGE AND LITERATURE

- A. Translation of Foreign language
- B. Bibliography preparation
- C. Analysis of Literary styles
- D. Analysis of Shakespearean texts
- E. Essay analysis

#### VII. PHYSICAL AND LIFE SCIENCES

- A. Medical literature analysis
- B. Anesthesiology training
- C. Patient clinical information retrieval
- D. Rorschach test analysis
- E. Interpretation of organic chemical formulas

#### LABORATORY

The class should investigate and present for discussion advances in the areas covered and try to add new applications in an effort to prepare for their individual problem at the final stage of the course.



### INDIVIDUAL PROBLEM

Suggested Time: Thirty hours

Content: Presentation of guidelines to be followed by the participant, in the development of his individual problem, utilizing the information previously presented in the curriculum.

Major Divisions:

- I. PROBLEM SELECTION
- II. PROBLEM SOLUTION FORMAT
- III. IMPLEMENTATION
- IV. FINAL DOCUMENTATION

Objective:

To develop student implementation of data processing knowledge on an individual basis. Emphasis changes in this section from group participation in the classroom to an individual problem of a creative nature. Class participants have been exposed to the basic considerations of data processing in all of its operational phases. The value of the training received in the course-to-date will be demonstrated by the individual participants when applying their knowledge to a practical problem.

The curriculum presented here emphasizes the importance of having the class participant apply what has been learned, to a problem that is of particular interest to him. The selection of the problem is up to the discretion of the participant; however, certain guidelines and suggestions are given within this section to guide them in their presentation format.

## INDIVIDUAL PROBLEM

### I. PROBLEM SELECTION

It is recommended that each class participant be required to submit a written problem proposal. The purpose of this proposal is to evolve a logical formulation of a plan which he will pursue for the remainder of the course.

The instructor will evaluate each proposal to determine if data processing offers a feasible solution. Otherwise, the instructor may guide the participant toward an alternate approach to his problem or suggest selection of another problem.

### II. PROBLEM SOLUTION FORMAT

Upon proposal approval the participant will develop the following sections:

A. Title Page - showing the working title of the proposal along with the identifying information of the participant.

B. Problem Statement - a brief, but adequate statement of the problem.

C. Methodology - a detailed description or outline of the manner in which research is to be conducted. This section should include references to any flowcharts, programs, and other general documentation procedures.

D. Objectives - brief description of expected end result.

The instructor's review and approval should precede further development.

### III. IMPLEMENTATION

The participant, using predetermined methods, will finalize the design of each element of the problem, code and test programs. Documentation to be developed in this section should include:

- A. Flowcharts
- B. Input/output layouts
- C. Record design
- D. Program listings
- E. Operation manuals

Close contact should be maintained between the instructors and participants throughout this phase to prevent wasted effort. The instructor may guide and assist, but emphasis must be reflected in individual effort.

### IV. FINAL DOCUMENTATION

The end result of the participants' project should be presented in the form of a thesis. All documentation previously developed should be incorporated, in addition to a final summary. The following elements may be incorporated:

- A. The participant's evaluation of the project, in terms of the success in meeting the original objectives.
- B. Recommendations for further developments.
- C. Bibliography, indicating other projects in the same area.
- D. Contribution to the field of education produced by the project.
- E. Conclusions, reflecting the end result of the participant effort.

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Applications in school administration, with sample card layouts, report forms, and application flowcharts.

IBM, S/360 - COBOL - Programmers Reference Manual, 1967.

A highly technical reference manual, for use by programmers. A source of detailed information on all areas of IBM COBOL.

IBM, S/360 R. P. G. R29 - 0090-R29-0099.

A programmed instruction course designed for the novice, requiring approximately 16-25 hours. Presented in the form of a self teaching text complete with problems and exercises.

IBM, University - College Information Systems, E20-0075.

A discussion of student records, financial administration, planning, and development administration.

International Information Incorporated, Proceeding of the Fourth Annual National Colloquium on Information Retrieval, 1967.

Papers delivered in May 1967. The conference theme was "The Users Viewpoint, An Aid to Design". Subjects range from many design facets to new areas of applications.



Kairam, Richard A., and Marker, Robert W., Educational Data Processing: New Dimensions and Prospects, Houghton-Mifflin Company, 1967.

Collected articles and addresses on data processing concepts and applications as they apply to education. The articles cover a broad range - from conceptual principles to 100 uses for school data processing. Many applications are discussed: pupil transportation procedures, PEXT, simulation, guidance research.

Kantner Jerome; The Computer and the Executive, Prentice-Hall Inc., 1967.

A discussion of computers from management viewpoint, including present and future applications, including real time systems. Explores the questions that must be resolved by a company going into data processing.

Langenbach, Robert G., Introduction to Automated Data Processing, Prentice-Hall Inc., 1968.

A basic survey of data processing. A variety of input and output media is covered, with many illustrations. Programming concepts are discussed, utilizing a hypothetical computer.

Laurie, Edward J., Computers and Computer Languages, South-Western Publishing Company, 1966.

A detailed discussion of various programming languages: absolute, assembler, Fortran, and COBOL.

Leslie, Harry; The Report Program Generator, Dataration, June 1967.

Useful for a novice to become aware of current trends. A sample program, written in both RPG and COBOL, is illustrated. The author, who was instrumental in developing an RPG compiler, presents many advantages of RPG.

Lott, Richard W., Basic Data Processing, Prentice-Hall Inc., 1967.

An introductory text covering the entire field of data processing, including illustrations and problems. Several applications are illustrated; grade reporting is illustrated as a manual system, punched card system, and several types of computer systems.

Lott, Richard W., Problems in Data Processing, Prentice-Hall, Inc., 1967.

A 64 page volume of classroom problems, which may be used to supplement various textbooks. The problems cover 4 areas: the punched card, computer concepts, programming, systems analysis and design. The problems are of a discussion nature, no solutions are given.

Martin, James, Programming Real-Time Computer Systems, Prentice-Hall, 1965.

A clear presentation of the concepts, techniques, and problem areas of real-time processing, with examples of several types of applications.

The introductory chapters constitute an excellent overview of real-time processing. The author has included a flow-chart to instruct the readers, with varying degrees of interest, in how to read this book.

McCameron, Fritz A., COBOL Logic and Programming, Richard D. Irwin, Inc., 1966.

An introduction to computers and programming. COBOL is discussed in terms of logic as well as coding functions, with class exercises.

McCracken, Daniel; A guide to COBOL Programming, John Wiley and Sons, 1963.

Written for the individual who wishes to get a rapid grasp of the COBOL language. The introductory chapter and case studies present excellent background information of data processing methods. Written to be used as either a class text or as teachers guide.

The author uses case studies to express each point and to hold the students attention. These case studies get increasingly more complex as the student proceeds with the course. Each chapter concludes with a quiz on the information covered in that chapter and the last chapter is an advanced class problem.

NEA Journal, How Will Computers Affect the Schools, February 1967.



A special feature consisting of several articles dealing with many aspects of the computer in education. A supplemental reading list is included.

D. F. Parkhill, The Challenge of the Computer Utility, 1966.

The history, realities and philosophies of computer utilities. It presents easily understood descriptions of the concept of information processing where the services of the computer are supplied directly to the user in his home, factory, or office, discussing the economic considerations and social implications.

Patrick, Robert L., Counting Generations, Journal of Data Management, June 1968.

This is a description of the author's own experiences with first, second, and third generation of computer hardware and software and his recommendations for avoiding problem areas.

Pollack and Sterling, Computer and the Life Sciences, Columbia University Press, 1965.

Covers statistical and non-statistical applications, simulation, diagnostic aid, nuclear medicine and other interesting applications in the Life Sciences. An interesting chapter titled "Establishing Computer Facilities" discusses staff requirements for a Life Science computing facility.

RCA, COBOL-Programmers Training Manual, Spectra 70, 1967.

A text designed for either self instruction or classroom use. Teaches COBOL for the RCA Spectra 70 series of computers. Complete with class problems and solutions.

RCA, Introduction to Electronic Data Processing, A Self-Study Training Manual, 70-00-901, 1967.

A programmed instruction manual dealing with third generation concepts. Operating systems and systems analysis are discussed.

RCA, Instant Legislative Information System, Florida Pioneers Data Bank for Law-makers, 1967. Form No. 80-70-042.

This brief booklet describes the operation of a computer system for legislation information.

RCA, Instructional Systems, 1968. IS-207-0268.

A booklet explaining the use of a third-generation computer in computer-based instruction, the various reports provided by the system (Concept Block Progress Report, Problem and Problem/Latency Analysis Report), and the software available.

RCA, Introduction to Operating Systems Information Manual, 1967.

This manual presents a basic introduction to the subject with illustrations, and a discussion of the features of several operating systems.

RCA, Systems Standard Reference Manual, 1967.

Software and hardware of all RCA Spectra 70 systems is described in a general manner.

Rosen, S., Programming Systems and Languages, McGraw-Hill, 1967.

A collection of papers including discussions of operating systems.

Saxon, James A., COROL: A Self-Instructional Programmed Manual, Prentice-Hall, Inc., 1963.

Covers the basics of electromechanical and computerized data processing, and all three levels of programming languages: machine, symbolic, and compiler. Includes an overview of applications in business and scientific applications.

Scientific American, special issue on Information, 215, 3, September 1966.

Entire issue devoted to computer technology and applications. Describes hardware and applications in science and education.

SDC Magazine, March 1966.

This issue describes the current state of the data processing industry and projections for the future.

Siligsolm, I. J. Your Career in Computer Programming, Messner, 1967.

Written in "layman" language, makes interesting reading, containing pertinent statistics.

Systems and Procedures Association, Business Systems, 1966.

Designed as a college textbook, covering many facets of the systems field.

Systems and Procedures Association Ideas for Management, 1967.

This volume contains papers delivered at the 1967 International Systems Meeting, covering the latest concepts in the systems field. Many of the subjects are of general interest to a student of data processing and well presented in a non-technical manner.

The articles on Decision Tables and Computer Systems Documentation Standards would be of interest to a student. Several articles, such as Everyman's Computer and Programmed Instruction, would be useful as supplemental reading.

Western Data Processing Center, Progress Report 7, Los Angeles: Graduate School of Business Administration University of California, 1965.

A report on computer projects which include simulation and instructional uses (e.g., UCLA Marketing Game used as a classroom teaching aid) in addition to problem solving uses in many fields.

Wilkinson, Bryan, Some Problems With Time-Sharing, Datamation, May 1968.

Most published articles describe the great successes of EDP. Mr. Wilkinson chose to be more honest and describes the problems encountered in achieving success. A newcomer to EDP has no conception of those problems, and while this article may be an extreme situation, it is informative and realistic.

Wohl, Gerald; The Use of Generalized "Packaged" Computer Programs.  
Richard D. Irwing, Inc., 1967.

A workbook supplement illustrating the use of package programs and a series of COBOL programs. IBM 360 COBOL is used, however, with minor modifications the programs can be used on many other systems.

APPENDIX I

REFERENCE INFORMATION

Annual Review of Information Science and Technology: Interscience Publishers, Inc., 605 3rd Avenue, New York, New York 10016.

A consolidation of the latest developments in information science and technology prepared by the American Society for Information Science.

Applied Science and Technology Index: H. W. Wilson Co., 950 University Avenue, Bronx, New York 10452.

A subject index of periodicals in the science and technology including automation.

American Society for Information Sciences: 2000 P Street, N. W. Washington, D. C.

Answers inquiries, provides references and makes referrals concerning all aspects of data processing.

Association of Educational Data Systems: 1201 16th Street, N. W. Washington, D. C. 20036.

Provides information by answering specific technical questions, referrals, and by consulting and advisory services.

Automation Research: SABE Press San Diego State College, San Diego, California 92115.

Listing of thesis, dissertations and independent studies.

Bibliography Index: H. W. Wilson Co., 950 University Avenue, Bronx, New York 10452.

A library service charged in accordance with the amount of service the use of the index affords the subscriber.

Burroughs Clearinghouse: Burroughs Corp., 6071 2nd Avenue, Detroit 32, Mich.

Technical publications relating to all phases of the data processing industry.

Business Periodicals Index: H. W. Wilson Co., 950 University Avenue, Bronx, New York 10452.

A cumulative index to periodicals in the fields of business including automation.

CAI - A Survey of the Literature, Entelek Incorporated, 42 Pleasant Street, Newburyport, Mass. 01950.

A survey of CAI with data culled from research reports, articles, books, and other documents.

Clearinghouse for Federal and Scientific Information, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Va. 22151.

U. S. Government's center for the collection and sale to the public of technical reports resulting from Government-financed research and development.

Computer-Assisted Instruction Guide, Entelek Incorporated, 42 Pleasant Street, Newburyport, Mass. 01950.

Detailed specifications on CAI programs developed at over 100 CAI centers, ranging from pre-school to adult industrial and military training.

Computer Characteristics Quarterly, Adams Associates, 128 The Great Road, Bedford, Mass. 01730.

Lists the salient features of essentially all digital computers and peripheral devices commercially available. Reissued in entirety four times a year.



Computer Directory and Buyers Guide, published each year in the technical magazine Computers and Automation.

A complete series of rosters covering all aspects of the electronical data processing industry.

Computer Notebook: Auerbach Information, Inc., 121 North Broad Street, Philadelphia, Pa. 19107.

Keeps subscriber aware of new developments in the computer field, conducts primary investigations of system features and limitations, compares operating performances of present systems with others, evaluates input/output equipment characteristics, reviews features, limitations, software and prices of new systems, supplemented monthly.

Computing Reviews: Association for Computing Machinery, 211 East 43rd Steet, New York, New York 10017.

A monthly publication with information on all current publications in computer science, including mathematics, engineering, natural and social sciences, and the humanities..

Datrix Service: University Microfilms Inc., Ann Arbor, Michigan 48106.

A source of dissertation titles in response to inquiries. Catalogs of key works are available on request.

Data Communications Reports: Auerbach Information, Inc., 121 North Broad Street, Philadelphia, Pa. 19107.

An analytical reference service on communication systems design, common-carrier facilities, comparison charts, communications terminal equipment and communications processing equipment, supplemented quarterly.

Data Handling Reports: Auerbach Information, Inc., 121 North Broad Street, Philadelphia, Pa. 19107.

Contains detailed information on Source Data Recording Equipment, Input preparation equipment, data transcription equipment, unit record equipment, forms handling equipment and supplies, supplemented quarterly.

Data Processing Systems Encyclopedia: American Data Processing, Inc.,  
19802 Mack Avenue, Detroit, Michigan 48236.

A useful general reference on computers and related devices,  
updated periodically.

Data Processing Yearbook: American Data Processing, Inc., Book Tower,  
Detroit, Michigan 48226.

List computer users' group, associations with an interest in  
data processing, data processing products and services, and manu-  
facturers of various products.

Defense Documentation Center: Cameron Station Building 5, 5010 Duke  
Street, Alexandria, Va. 22314.

DDC provides a central service for the dissemination of Department  
of Defense (DOD) scientific and technical reports.

Educational Resources Information Center (ERIC): Research in Education,  
Superintendent of Documents, U. S. Government Printing Office, Washington  
D. C., 20402.

Provides document and project indexes and resumes.

ICP Quarterly, 5704 N. Gilford Avenue, Indianapolis, Ind. 46220.

A publication listing computer programs available to buyers,  
with descriptions, sources, and price.

Information Research Center, Battelle Memorial Institute, 505 King Avenue,  
Columbus, Ohio 43201.

Provides information on the state of the art of information systems  
and other aspects of the communication of scientific and technical in-  
formation and data.

Knowledge Availability Systems Center: University of Pittsburgh,  
Pittsburgh, Pa.

In cooperation with NASA, this center tries to maintain the most  
recent scientific data on information systems materials.



Library of Congress Automation Techniques (LOCATE): Information Systems Office, Library of Congress, 2nd and Independence Avenue, S. E., Washington, D. C. 20540.

Collects and disseminates information concerning existing and proposed automation projects for use in libraries. Services include reference, referral, and services of materials in the exchange's file.

McGraw-Hill Encyclopedia of Science and Technology: McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York, New York 10036.

Mechanized Bibliography of Documentation and Information Sciences: Department Library, U. S. Department of the Interior, Washington, D. C. 20240.

Bibliography compiled by H. Holzbauer.

National Referral Center for Science and Technology: Library of Congress, Washington, D. C.

Requests for information should be on specific subjects (i.e. data processing, computers, etc.)

Scientific and Technical Information Division: National Aeronautics and Space Administration, Washington, D. C. 20546.

Provides a central service for the dissemination of scientific and technical reports dealing with the national space program.

Software Notebook: Auerbach Information, Inc., 121 North Broad Street, Philadelphia, Pa. 19107.

Reference service containing computer system software reports, fact-filled summaries of system characteristics, designed to facilitate comparisons.

Standard EDP Reports: Auerbach Information Inc., 121 North Broad Street, Philadelphia, Pa. 19107.

Ten volumes consisting of detailed reports in computer systems analyzing system performance, equipment and software, updated monthly.

The ten volumes can be obtained in specialized subsets of an eight volume edition contains information on systems that have general application to business and scientific problems and a three volume edition which reports on scientific and control computers.

Technology Information Exchange: National Bureau of Standards, Center for Computer Sciences and Technology, Connecticut Avenue and Van Ness Street, N. W. Washington, D. C. 20234.

A specialized information center which provides technical support to members of the computer community, also answers inquiries on government automation projects and makes referrals.

APPENDIX II

AUDIO-VISUAL AIDS

The ABC's of Computers, 16 mm., 25 minutes, General Electric Company.

A brief description of the basic principles of computers.

The ADA Story, 16 mm., 28 minutes, color, R.C.A.

A Lockheed production illustrating data collection from a four factory complex linking 400 information points with a centralized computer system.

Automation, (From "See it Now" TV Series) 16 mm., 84 minutes, Pennsylvania State University.

Television reporter, Edward R. Murrow, presents some of the problems associated with the advance of automation, and covers its use in a wide variety of industries. Interviews with prominent personalities explore the social and economic impact of automation.

COBOL, (Produced by Westinghouse) 35 mm., 20 minutes, color, Burroughs Corporation.

The Computer Comes to Marketing, 16 mm., 30 minutes, Fortune Films.

A description of computer applications in marketing and the benefits of data processing.

Computer Programming, 16 mm., 26 minutes, System Development Corporation.

Illustrates the functions of a programmer.

Computer Units, 16 mm., 24 minutes, color, Norwood Films.

An introduction to the basic components of a computer system and their functions.

Digital Computer Techniques, 16 mm., 18 minutes, color, U. S. Navy.

A general introduction to computers.

Electronic Computer Language Translation, 16 mm., 31 minutes, National Science Foundation.

A description of the computerized techniques of Russian translation to English.

The Electronic Shelf, 16 mm., 20 minutes, color, Univac.

Information retrieval techniques using Univac mass storage devices.

Electronics for Accounting and Business, 16 mm., 23 minutes, color Arthur Anderson & Company.

Introduction to computers and applications in industry.

The Flow Process Chart, 16 mm., 15 minutes, color, City College of New York.

Demonstrates the use of flow charts and diagrams.

The Information Machine, 16 mm., or 35 mm., 10 minutes, color, IBM.

A colorful animated account of the development of the electronic computer and ending with simulation.

Information Retrieval, 16 mm., 18 minutes, color, IBM.

The development of information retrieval procedures by a theoretical company utilizing data processing systems. Includes KWIC indexing and document retrieval.

Innsbruck - Tokyo - 64, 16 mm., 9 minutes, color, IBM.

Explanation of the collection, computation, and immediate world wide distribution of the results of the 1964 summer and winter olympic games.

Introduction to Digital Computers, 16 mm., 25 minutes, color, Univac.

An animated description of the basic functions of a computer.

Logic On A Chip, 16 mm., 9 minutes, color, RCA.

A presentation on integrated monolithic circuitry as third generation electronics for RCA computers.

One Step Behind - One Step Ahead, 16 mm., 30 minutes, System Development Corporation.

Jack Webb narrates the story of a criminal in a dramatization of the use of the New York State Identification and Intelligence System.

Operating Systems, 16 mm., 60 minutes, IBM.

A lecture describing the reasons for an operating system and how they are implemented.

Piercing the Unknown, 16 mm., 22 minutes, color, IBM.

Describes the development of computer technology and some uses in science and industry.

Principles of Electronic Data Processing, 16 mm., 16 min., color, free loan, IBM.

A complete discussion of the basic principles of electronic data processing is embodied in this movie. It explains the provisions for input, storage, processing, and output of data at the speed of light, and in infinitesimal space. It touches on such things as punched cards, paper and magnetic tape, magnetic ink, magnetic core, disk and tape storage, central processing and console control.

Programming Languages, 16 mm., 5 minutes, color, System Development Corporation.

An introduction to programming languages, partially animated.

RPG for System/360, Audio Education, Department of Education, IBM.

This is a programmed instruction course consisting of a class notebook and an audio tape recording. The course required approximately one 2 1/2 hour session and covers 360 Report Program Generator for card, tape, and disk.

Small Miracle, 16 mm., 14 minutes, color, IBM.

A description of the use of computers in man's search for knowledge with illustrations in space technology, bridge design, and others.

Space Age Administration, 16 mm., 20 minutes, color, RCA.

Personnel records of the Air Reserve maintained by computer to aid in maintaining readiness.

Systems, 16 mm., 14 minutes, IBM.

An explanation of how computers are used as a problem-solving tool in government, science, and industry.

Then and Now, 16 mm., 12 minutes, color, Univac.

The development of ENIAC, the first electronic computer, and a discussion by the designers, J. Eckert and Dr. Mauchly.

This Business of Numbers, 35 mm., color, 20 min., free loan, UNIVAC.

From the cavemen to the modern scientist, arithmetic is traced with amusing cartoons from its beginning to modern data-processing systems.

Time Sharing on the Air, 16 mm., 30 minutes, System Development Corporation.

A description of the SDC time-sharing system, which services many users at remote teletype stations.

To Bridge the Gap, 35 mm., color, 18 minutes, Burroughs Corporation.

Concepts and some uses of paper, tape as a media for data recording.

SLIDES

CAI for Educators, IBM.

COBOL, IBM.

Data Management, IBM.

EDP and Accounting Machine Comparison, NCR.

Payroll Accounting, Univac.

PERT Cost, IBM.

Remote Access Computing, IBM.

Teleprocessing, IBM.

Ten Commandments, NCR.

University and College Information System, IBM.

360 DOS TOS BOS (Operating Systems), IBM.



Additional audio visual aids relating to specific computer configurations are available from computer manufacturers. The aids listed and additional information can be obtained from the following sources.

Air Force Film Library Center, 8900 South Broadway, St. Louis, Mo. 63125.

American Management Association, 1515 Broadway, New York, N. Y. 10036.

Arthur Anderson & Company, 1320 West 3rd Street, Los Angeles, Calif. 90000.

Audio-Visual Aids for Automation, Bureau of Business and Economic Research, San Diego State College Foundation, San Diego, Calif. 92115.

Burroughs Corporation, 6071 2nd Ave., Detroit, Michigan 48202.

Fortune Films, Time and Life Bldg., Rockefeller Center, New York, N. Y. 10020.

General Electric Company, 7800 Wisconsin Ave., Bethesda 14, Maryland 20014.

Honeywell Inc., E. D. P. Division, Waltham, Mass.

IBM Corporation, 590 Madison Ave., New York, N. Y. 10022 (And Local Offices)

McGraw-Hill Text Films, 330 West 42nd Street, New York, N. Y. 10036.

Modern Talking Picture Service, 160 E. Grand Ave., Chicago, Ill. 60611.

National Cash Register Company, EDP Division, Dayton 9, Ohio 45400.

National Science Foundation, Dr. Howard J. Hausman, Secondary School Program, Washington 25, D. C.

Net Film Service, Audio-Visual Center, Indiana University, Bloomington, Indiana 47401.

Norwood Films, 926 New Jersey Ave., N. W. Washington, D. C. 20001.

Radio Corporation of America, Electronic Data Processing, Sales Department, Camden, New Jersey 08101.

System Development Corporation, 2500 Colorado Ave., Santa Monica, Calif. 90406.

U. S. Army Central Film and Equipment Exchange, Army Headquarters, Arlington Hall Station, Arlington, Virginia 22200.

United States Navy, Headquarters of the Commandant, Third Naval District, 90 Church Street, New York, N. Y. 10000.

Univac--Division of Sperry Rand Corporation, Audio Visual Aids Department, 315 Park Ave., New York, N. Y. 10010.



University of Southern California, Film Distribution Department of  
Cinema, University Park, Los Angeles, California 90000.

3M Company, Visual Products Division, 2501 Hudson Road, St. Paul,  
Minnesota 55101.

APPENDIX III

TECHNICAL SOCIETIES

AMERICAN FEDERATION OF INFORMATION PROCESSING SOCIETIES (AFIPS)

AMERICAN MANAGEMENT ASSOCIATION (AMA)

ASSOCIATION FOR COMPUTING MACHINERY (ACM)

ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS (AEDS)

BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION (BEMA)

DATA PROCESSING MANAGEMENT ASSOCIATION (DPMA)

INTERNATIONAL FEDERATION OF INFORMATION PROCESSING (IFIP)

INTERUNIVERSITY COMMUNICATIONS COUNCIL (EDUCOM)

SOCIETY FOR AUTOMATION IN BUSINESS EDUCATION (SABE)

SYSTEMS AND PROCEDURES ASSOCIATION (SPA)

AMERICAN FEDERATION OF INFORMATION PROCESSING SOCIETIES (AFIPS)  
211 East 43rd Street  
New York, New York 10017

AFIPS formed on May 10, 1961 as an outgrowth of the National Joint Computer Committee (NJCC).

AFIPS is a society founded to promote the advancement and dissemination of knowledge of the information processing societies. Membership is open to members of societies engaged in or interested in information processing.

Publications:

The Proceedings of each Joint Computer Conference.

AMERICAN MANAGEMENT ASSOCIATION  
The American Management Assoc., Bldg.  
135 West 50 Street  
New York, N. Y. 10020

The American Management Association is a non-profit educational society organized to find, develop, and share better methods of management.

It was formed in 1923 through mergers of several small organizations. Membership is open to individuals and firms desiring to take part in AMA's Management Education Programs.

**Publications:**

The Management Review  
Management Reviews  
The Managers Letter  
Personnel

ASSOCIATION FOR COMPUTING MACHINERY (ACM)  
211 East 43rd Street  
New York, N. Y. 10017

ACM, organized in 1947, is perhaps the most technically oriented of all the data processing organizations. It was organized for two purposes (1) "to advance the sciences and arts of information processing" (2) "to promote the free interchange of information about the sciences and arts of information processing both among specialists and among the public in the best scientific and professional tradition."

Any person or institution having accord with the purposes of the association may obtain membership in one of the three recognized classes. (1) institutional (2) regular (3) student membership.

**Publications:**

Journal of the Association for Computing Machinery  
Communications of the ACM  
Computing Reviews  
Comprehensive Bibliography of Computing Literature

ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS (AEDS)  
1201 16th Street, N. W.  
Washington, D. C. 20036

AEDS was formed in 1962 as a professional association for educational data processing and information management personnel. Its membership consists of school and university computer centers and officials of state departments of education.

**Publications:**

AEDS Bulletin  
EDP Newsletter  
Journal of Educational Data Processing  
Monitor

BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION (BEMA)  
235 East 42nd Street  
New York, New York 10017

Originally organized in 1916 as the Office Equipment Manufacturers Institute, renamed in July 1961. It represents the business equipment industry and was founded to conduct programs designed specifically for the needs and problems of its members.

Examples of these programs are market research, establishment of standards and the Business Equipment Exposition.

**Publications:**

News Bulletin

DATA PROCESSING MANAGEMENT ASSOCIATION (DPMA)  
524 Busse Highway  
Park Ridge, Illinois 60068

DPMA was founded to improve the data processing profession by creating better understanding of the characteristics of data processing. The areas of particular importance are education, dissemination of knowledge, and the proper relationship of data processing to management.

It was founded as the National Machine Accountants Association in 1951. In 1965 the name was changed to Data Processing Management Association to reflect the changes of the role of its members in data processing.

DPMA has 3 classes of membership: Regular membership is open to persons employed in managerial positions in data processing. Associate membership is open to those persons whose occupational activities are related to direct selling of data processing equipment and supplies. Honorary membership can be conferred on persons making certain contributions to the data processing community.

**Publications:**

Journal of Data Management  
DPMA Quarterly

**INTERUNIVERSITY COMMUNICATIONS COUNCIL (EDUCOM)**

EDUCOM was established a few years ago to aid in applying technology to the educational process.

About 70 major colleges and university's representing 200 campuses are members.

EDUCOM operates from central offices with task forces of experts in the fields of information networks, educational systems, education of professional personnel, clinical operations, legal and related matters.

**INTERNATIONAL FEDERATION FOR INFORMATION PROCESSING (IFIP)**  
345 East 47th Street  
New York, New York 10017

IFIP was officially formed in 1960 as a result of a conference, in 1959, sponsored by the United Nations Cultural organization.

The purpose of IFIP is to promote international cooperation in the dissemination and advancement of information processing and the examination of related areas.

Membership is limited to one organization from each country.

**Publications:**

IFIP Bulletin  
IFIP News  
Proceedings of IFIP

**SOCIETY FOR AUTOMATION IN BUSINESS EDUCATION (SABE)**

**Dr. E. Dana Gibson, President  
Professor of Office Management  
San Diego State College  
San Diego, California 92115**

SABE was founded in May 1961 to advance the cause of business education. The areas of involvement are automation, programmed learning, computers, data processing and related areas.

**Publications:**

**SABE Data Processor**

**SYSTEMS AND PROCEDURES ASSOCIATION (SPA)**

**7890 Brookside Drive  
Cleveland, Ohio 44131**

SPA was originally formed in 1944. Through a number of mergers of similar groups, the Systems and Procedures Association was formed.

The purpose of the organization is to give information and exchange ideas relative to systems and procedures. Membership is open to all persons actively engaged in systems and procedures.

**Publications:**

**Systems and Procedures Journal**  
**International Newsletter**  
**Idea on Management**

APPENDIX IV

TECHNICAL JOURNALS AND MAGAZINES

The following is a list of trade magazines, periodicals and technical journals which would be desirable reading material for persons involved in data processing education.

Business Automation 288 Park Ave. West Elmhurst, Ill. 60168.

Communications of the ACM Association for Computing Machinery, 211 East 43rd Street New York, New York 10017.

Computers and Automation Berkeley Enterprises, Inc., 815 Washington Street, Newtonville, Mass. 02160.

Computer Characteristics Quarterly Adams Associates Inc., 575 Technology Square, Cambridge, Massachusetts. 02139.

Computer Digest American Data Processing, Inc., 4th Floor, Book Building, Detroit, Mich. 48226.

Computer and the Humanities (Newsletter) Queens College of the City University of New York, Flushing, New York. 11367.

Computing Newsletter for Schools of Business, University of Colorado, Boulder, Colorado 80302.

Computerworld News Bulletin Computerworld, Inc., 60 Austin Street Newton, Mass. 02160.

Datamation F. D. Thompson Publications, Inc., 205 West Wacker Dr., P. O. Box 2000 Greenwich Conn. 06830.

Data Processing Digest Data Processing Digest, Inc., 1140 South Robertson Blvd., Los Angeles, California. 90035.

Data Processing for Education American Data Processing Inc., 4th Floor, Book Building, Detroit, Michigan. 48226.

Data Processing Magazine Data Processing Magazine, 134 North 13th Street, Philadelphia, Pa. 19107.

Data Processor International Business Machines Corp., White Plains, New York 10601.



DPMA Quarterly Data Processing Management Association, 505 Busse Highway, Park Ridge, Illinois 60068.

Honeywell Computer Journal Honeywell Inc., Electronic Data Processing Division, Wellesley Hills, Mass. 02181.

Information Retrieval Letter American Data Processing, Inc., 4th Floor, Book Building, Detroit, Michigan 48226.

Journal of Data Management Data Processing Management Association, 505 Busse Highway, Park Ridge, Illinois 60068.

Journal of the Association for Computing Machinery 211 East 43rd Street, New York, New York 10017.

Modern Data Systems Circulation Department, Modern Data Systems, 120 Brighton Road, Clifton, New Jersey 07012.

News Report, News Report, 2101 Constitution Avenue, N. W. Washington, D. C. 20418.

SDC Magazine, Document Distribution, SDC.

Supervisory Management, American Management Association, Inc., 135 West 50th Street, New York, New York 10020.

Systems, United Business Publications, Inc., 200 Madison Avenue, New York, New York 10016.

Systems and Procedures, Systems and Procedures Association, 7890 Brookside Drive, Cleveland, Ohio 44138.

Technical News Bulletin, U. S. Department of Congress, National Bureau of Standards, Washington, D. C. 20234.

Think IBM, Armonk, New York 10504.



APPENDIX V

DIRECTORY OF MANUFACTURERS

ADAGE, Adage, Incorporated, 1079 Commonwealth Avenue, Boston, Massachusetts 02115.

AMPEX, Ampex Corporation, Computer Products Division, 9937 West Jefferson Boulevard, Culver City, California 90230.

ANAELEX, Anaelex Corporation, 150 Causeway Street, Boston, Mass. 02114.

AUTOMETICS, Autonetics, A Division of North American Aviation, Inc., 3330 Miraloma Avenue, Anaheim, California 92803.

BBN, Bolt, Beranek & Newman, Inc., Data Equipment Division, 15808 Wyandotte Street, Van Nuys, California 91406.

BECKMAN, Beckman Instruments, Inc., Systems Division, 2400 Harbor Boulevard, Fullerton, California 92631.

BIT, Business Information Technology, Inc., 3 Erie Drive, Natick, Massachusetts 01760.

BRYANT, Bryant Computer Products Div., of Ex-Cello-0 Corporation 850 Ladd Road, Walled Lake, Michigan 48088.

BUNKER-RAMO, Bunder-Ramo Corporation, 8433 Fallbrook Avenue, Canoga Park, California 91304.

BURROUGHS, Burroughs Corporation, 6071 Second Avenue Detroit, Michigan 48200.

COLLINS, Collins Radio Company, Comm. and Data Systems Division, Dallas Texas 75207.

COMPUTER COMMUNICATIONS, Computer Communications, Inc., 701 West Manchester Boulevard, Inglewood, California 90301.

CONRAC, Div., of Giannini Controls Corporation, 600 North Rimsdale, Covina, California 91722.

CONTROL DATA, Control Data Corporation, 8100 34th Avenue South., Minneapolis, Minnesota 55420.  
Control Data Corporation, Data Display Division, 2401 North Fairview Avenue, St. Paul, Minnesota 55113.

DATA DISC, Data Disc, Inc., 1275 California Avenue, Palo Alto, California 94304.

DATAMARK, Datamark, Incorporated, Cantiague Road, Westbury, New York 11590.

DATAMEC, Datamec Corporation, 345 Middlefield Road, Mountain View, California 94040.

DATA PRODUCTS, Data Products Corporation, 5535 Warner Drive, Culver City, California 90231.

DIGITAL DEVELOPMENT, Digital Development Corporation, 5575 Kearny Villa Road, San Diego, Calif. 92123.

DIGITAL EQUIPMENT, Digital Equipment Corporation, Main Street, Maynard, Massachusetts 01754.

DIGITRONICS, Digitronics Corporation, Albertson Avenue, Albertson, New York 11507.

EAI, Electronic Associates, Inc., West Long Branch, New Jersey 07764.

EMR, EMR Computer Division, 8001 Bloomington Freeway, Minneapolis, Minnesota 55420.

GENERAL ELECTRIC, Information Systems, 13430 N. Black Canyon Highway, Phoenix, Arizona 85029.

GENERAL PRECISION, General Precision, Librascope Group, 1100 Frances Court Glendale, Calif. 91306.

HEWLETT PACKARD, Hewlett Packard, Dymec Division, 395 Page Mill Road, Palo Alto, Calif. 94306.

HONEYWELL, Honeywell, Computer Control Division, Old Connecticut Path, Framingham, Massachusetts 01701.  
Honeywell, Electronic Data Processing Div., 60 Walnut Street, Wellesley Hills, Massachusetts 02181.

HUGHES, Hughes Aircraft Company, Data Processing Products Division, Fullerton, Calif. 92634.

IBM, International Business Machines Corp., Data Processing Division, 112 East Post Road, White Plains, New York, 10600.

IDI, Information Displays, Inc., 102 East Sandford Boulevard, Mount Vernon, New York 10550.

INFORMATION INTERNATIONAL, Information International, Inc., 200 Sixth Street, Cambridge, Massachusetts 02142.

INTERDATA, Interdata, 2 Crescent Place, Oceanport, New Jersey 07757.

ITT, International Telephone & Telegraph Company, Federal Laboratories, 3700 East Pontiac Street, Fort Wayne, Indiana 46803.

LFE, Laboratory for Electronics, Inc., Electronics Division, 1075 Commonwealth Avenue, Boston, Massachusetts 02215.

ISI, Lear Siegler, Inc., Electronic Instruments Division, 714 North Brookhurst Street, Anaheim, Calif., 92803.

MIDWESTERN, Midwestern Instruments, Inc., 41st Street & Sheridan Road, Tulsa, Oklahoma 74135.

MONROE, Monroe Calculating Machine Co., 555 Mitchell Street, Orange, New Jersey 07050.

NCR, National Cash Register Co., 1324 South Paterson Boulevard, Dayton, Ohio 45400.

PACIFIC DATA, Pacific Data Systems, Inc., 644 Young Street, Santa Ana, California 92705.

PHILCO, Philco Corporation, Subsidiary of Ford Motor Co., 3900 Welsh Road, Willow Grove, Pa. 19090.

POTTER, Potter Instruments Co., Inc., 151 Sunnyside Boulevard, Plainview Long Island, N. Y. 11803.

RAYTHEON, Raytheon Corp. 2700 South Fairview Street, Santa Ana, California 92704.

RCA, Radio Corporation of America, Information Systems Div., Cherry Hill, New Jersey 08034.

REMEX, Remex Electronics, 5250 W. El Segundo Boulevard, Hawthorne Calif. 90250.

ROYTRON, Roytron Division, Royal Typewriter Company, Inc., 150 New Pard Avenue, Hartford, Connecticut 06101.

SANDERS, Sanders Associates, Inc., 95 Canal Street, Nashua, New-Hampshire 03060.

SCIENTIFIC CONTROL, Scientific Control Corporation, 14008 Distribution Way, Dallas, Texas 75234.

SEL, Systems Engineering Laboratories, Inc., Post Office Box 9143,  
Fort Lauderdale, Florida 33310.

SOROBAN, Soroban Engineering, Inc., Post Office Box 1690, Melbourne,  
Florida 32902.

STANDARD COMPUTER, Standard Computer Corporation, 1411 West Olympic  
Boulevard, Los Angeles, Calif. 90015.

STOMBERG-CARSON, Stomberg-Carlson Corporation, Data Products Division,  
Post Office Box 2449, San Diego, Calif. 92112.

TALLY, Tally Corporation, 13110 Mercer Street, Seattle, Washington 98109.

TASKER, Tasker Industries, 7838 Orion Avenue, Van Nuys, Calif. 91409.

TEC-LITE, Transistor Electronics Corporation Post Office Box 6191,  
Minneapolis, Minnesota 55424.

UNIVAC, Sperry Rand Corporation, Univac Division, Blue Bell, Penna. 19422.

UPTIME, Uptime Corporation, 15910 W. 5th Avenue, Golden, Colorado 80401.

VARIAN DATA, Varian Data Machines, A Varian Subsidiary, 1590 Monrovia  
Avenue, Newport Beach, Calif. 92660.

VERMONT RESEARCH, Vermont Research, Precision Park, North Springfield,  
Vermont 05150.

WESTINGHOUSE, Westinghouse Electric Corporation, Research and Development  
Center, Pittsburgh, Pa. 15200.

APPENDIX VI

JOB DESCRIPTIONS

Manager of All Data Processing

Plans, organizes and controls the overall activities of electronic data processing including systems analysis, programming, and computer operation activities through managing subordinates or by direct supervision. Personally handles major personnel, administrative and data processing problems.

Assistant Manager of Data Processing

Under general direction, assists the manager in planning, organizing and controlling the various sections of the department. Usually has departmental line responsibility but in certain instances may only have departmental staff responsibility. Consults with and advises other departments with regard to feasibility, systems and procedures, and records control studies and problems. May act for the manager in his absence.

Manager or Supervisor of Systems Analysis

Plans, organizes and controls the activities of the Systems Analysis Section in the establishment and implementation of new or revised systems and procedures concerned with electronic data processing. Usually considered as being in full charge of all systems analysis activities. Responsible for feasibility studies and systems design involving electronic data processing and makes recommendations on the action to be taken. Assigns personnel to the various projects and directs their activities. Consults with and advises other departments on systems and procedures.

Lead Systems Analyst

Usually considered as the assistant manager of systems analysis. Has full technical knowledge of the activity and also has supervisory duties of instruction, directing and checking the work of the other systems analysis. Assists in planning, organizing and controlling the activities of the section. Assists in the scheduling of the work of the section and the assigning of personnel to the various projects being studied or processed. May act for the manager in his absence.



### Senior Systems Analyst

Under general direction, formulates logical statements of business problems and devises procedures for solutions of the problems. Usually competent to work at the highest level of all technical phases of systems analysis while working on his own most of the time. May give some direction and guidance to lower level classifications. Confers with management to define the data processing problem. Analyzes existing system logic difficulties and revises the logic and procedures involved as necessary. Develops logic and procedures to provide more efficient machine operations.

### Junior Systems Analyst

Under direct supervision, assists higher level classifications in devising computer system specifications and record layouts. Usually fairly competent to work on several phases of systems analysis with only general direction but still needs some instruction and guidance for the other phases. Studies and analyzes existing office procedures as assigned. Prepares systems flow charts to describe existing and proposed operations. Prepares comprehensive computer block diagrams in accordance with instructions from higher level classifications.

### Manager of Supervisor of Programming

Plans, organizes and controls the preparation of computer programs for the solution of business problems. Usually considered as being in full charge of all programming activities. Assigns, outlines and coordinates the work of programmers engaged in writing computer programs and routines. Establishes standards for block diagramming machine flow charting and programming procedures. May write and debug complex programs. Reviews and evaluates the work of the staff and prepares periodic performance reports. Collaborates with systems analysis, feasibility studies and systems planning.

### Lead Programmer

Usually considered as the assistant manager of programming. Has a full technical knowledge of programming. Also has supervisory duties of instructing, assigning, directing and checking the work of the other programmers. Assists in scheduling programming projects and in the assignment of personnel to the various projects. Coordinates the activities of the programming section with the other sections in the overall computer department. May act for the manager in his absence.

### Senior Programmer

Under general supervision, develops and prepares machine logic flow charts for the solution of business problems. Usually competent to work at the highest level of all technical phases of programming while working on his own most of the time. May give some direction and guidance to lower level classifications. Analyzes problems outlined by systems analysis in terms of detailed equipment requirements and capabilities. Designs detailed machine logic flow charting. Verifies program logic by preparing test data for trial runs. Tests and debugs programs. Prepares instruction sheets to guide computer operators during production runs. Evaluates and modifies existing programs to take into account changes in systems requirements or equipment configurations. May translate detailed machine logic flow charts into coded machine instructions. May assist in determining the causes of computer operation malfunctions. May confer with technical personnel in systems analysis and application planning.

### Junior Programmer

Under direct supervision, assists in the review and analysis of detailed systems specifications and the preparation of the program instructions. Usually fairly competent to work on several phases of programming with only general direction but still needs some instruction and guidance for the other phases. Assists in the preparation of all levels of block diagrams and machine logic flow charts. Codes program instructions. Assists in preparing test data and testing and debugging programs. Assists in the documentation of all procedures used throughout the system.

### Manager or Supervisor of Computer Operations

Plans, organizes and controls the operation of the computer and peripheral data processing equipment. Usually considered as being in full charge of all activities of equipment operations. Establishes detailed schedules for the utilization of all equipment to obtain maximum usage. Assigns personnel to the various operations and instructs them where necessary so they are trained to perform assigned duties in accordance with established methods and procedures. Reviews equipment logs and reports to the manager of data processing on equipment operation efficiency for the section.

### Lead Computer Operator

Usually considered the assistant manager of computer operations. Has supervisory duties of instruction, assigning, directing and checking the work of the other computer operators, including seniors. Assists in the scheduling of the operations and the assigning of personnel to the various items of equipment required for the computer functions. Coordinates activities of the section with other sections of the overall data processing department. May act as shift supervisor. May act for the manager in his absence.

### Senior Computer Operator

Under general supervision, monitors and controls computer by operating the central console. Usually competent to work at the highest level of all computer operation phases. May give some direction and guidance to lower level classifications. Studies program operating instruction sheets to determine equipment setup and run operation. Switches auxiliary equipment into circuit. Confers with technical personnel in the event errors require a change in instructions or sequence of operations. Maintains operating records such as machine performance and production reports.

### Junior Computer Operator

Under direct supervision, assists higher level classifications in monitoring and controlling computer. Usually fairly competent to work on several phases of computer operation with only general direction but still needs some instruction and guidance for the other phases. Assists higher level classifications in carrying out the various duties associated with operating a computer or the auxiliary equipment directly associated with the computer. May keep records regarding output units and maintain records for stores and supplies.

### Manager or Supervisor of Unit Record Equipment

Under supervision of the data processing manager, directs the personnel of the unit record department and manages the preparation of various reports and data. In non-computer installations may be considered manager of data processing with similar responsibility.

### Lead Operator, Unit Record Equipment

Usually considered as assistant to manager or supervisor of unit record department. Has technical responsibility for report preparation. In charge of scheduling and machine usage. Directs training of personnel.



Senior Operator, Unit Record

Under supervision, operates a  
in technical responsibility.

u

record

emer

assists

Junior Operator, Unit Record

Under direct supervision, operates

u

variet

quar

Keypunch Supervisor

Under direct supervision of  
manager, plans, schedules, supervising  
verifying activities, maintain  
assigned personnel carry out

and  
correc  
above

ad  
ses

Lead Keypunch Operator

Under direct supervision, operates  
instructs workers on procedure;  
assists in training new employ

punch  
o pe.

verifier ma  
outline ass. ents;

Junior Keypunch Operator

Under direct supervision, operates  
machines; performs related c

keypunch  
active

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